Notre Dame Law Review

Volume 71 | Issue 2 Article 8

6-1-1999

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I. INTRODUCTION

In a very rough sort of way, the search for a unifying economic theory of patents may be seen as paralleling the search for a unifying scientific theory of the universe. As put by physicist Steven Hawking in his best selling book, *A Brief History of Time*: "The eventual goal of science is to provide a single theory that describes the whole universe."[1] Nobel laureate, Leon Lederman, in his recent book, *The God Particle*, declares: "Unification, the search for a simple and all-encompassing theory, is the Holy Grail."[2] At present scientists must describe the universe in terms of two very basic partial theories—general relativity and quantum mechanics; unfortunately, these partial theories are known to be inconsistent with one another.[3] The general theory of relativity may be seen as describing the universe at the "macro" level, involving the force of gravity with respect to relatively large structures and distances.[4] Quantum mechanics theory may be seen as describing the universe at the "micro" level of extremely small structures and distances.[5]

Analogously, various theories have been developed in an attempt to describe the patent system.[6] These theories have usually been at the macro level to describe the overall patent system as providing a net economic benefit or loss to society. More recently, theories have been advanced for

1 STEVEN W. HAWKING, A BRIEF HISTORY OF TIME 10 (1988). While the book was a best seller, it probably was not one of the best read books. "Something like 5.5 million copies sold made Hawking's *A Brief History of Time* a runaway best seller that very few buyers actually read. And no wonder. It was all but impenetrable to anyone but a physicist." Clarence Petersen, *Tribune Books*, CHI. TRIB., Aug. 9, 1992, at C2; *see also* LEON M. LEDERMAN & DICK TERESI, THE GOD PARTICLE (1993); STEVEN WEINBERG, DREAMS OF A FINAL THEORY (1993).

2 LEDERMAN & TERESI, *supra* note 1, at 348. A decade earlier John Gribbin reflected the same metaphor: "[T]he Holy Grail of physicists today is a true unification of [general relativity and quantum mechanics] into one grand theory." JOHN GRIBBIN, IN SEARCH OF SCHRODINGER'S CAT: QUANTUM PHYSICS AND REALITY 175 (1984).

3 HAWKING, *supra* note 1, at 11-12.

4 *Id.* at 11.

5 *Id.*

6 The theories may be morally or justice based or, more recently, economically based. The description has generally been in support of or in opposition to the patent system. The various classical theories of patents are described and critiqued in EDITH TILTON PENROSE, THE ECONOMICS OF THE INTERNATIONAL PATENT SYSTEM (1951); STAFF OF SENATE SUBCOMM. ON PATENTS, TRADEMARKS AND COPYRIGHTS, 85TH CONG., 2D SESS., AN ECONOMIC REVIEW OF THE PATENT SYSTEM, STUDY NO. 15 (COMM. PRINT 1958) (F. Machlup, auth.) [hereinafter Machlup]. Steven Cheung summarizes the views of influential economic analysts:

> One view—advanced by Bentham (1795) and shared by Say (1803), Mill (1848), and Clark (1907)—holds that patent rights are absolutely necessary to encourage inventions. A second view, advanced by Taussig (1915) and shared by Pigou (1920), maintains that a system of patent rights is largely superfluous. Third, Plant (1934), with modern followers, argued that a patent system is actually detrimental. Finally, Arrow (1962), . . . argued that although property rights in ideas are clearly useful, they are nonetheless inferior to direct government investment in inventive activities.

Steven N.S. Cheung, *Property Rights and Invention*, *in* 8 RESEARCH IN LAW AND ECONOMICS 5, 5-6 (John Palmer & Richard O. Zerbe, Jr. eds., 1986). *See generally* JOHN W. SCHLICHER, PATENT LAW LEGAL AND ECONOMIC PRINCIPLES ch. 2 (1993); K.W. Dam, *The Economic Underpinnings of Patent Law*, 23 J. LEGAL STUD. 247 (1994). Other literature relating to the economics of the patent system will be cited *infra* at appropriate points.

describing the patent system at a micro level in terms of explaining the outcome of actual patent validity decisions.[7]

The physics analogy may be carried further into classical and modern periods. The classical period in physics (in particular, Newtonian mechanics) ended with quantum mechanics.[8] The classical theories of the patent system would include natural law/justice based theories (principally the "reward" theory)[9] and pragmatic or economics based theories (principally the "patent-induced" theory).[10] The modern era in patent economic theory may be seen as beginning in 1977 with Kitch's publication of an article describing the "prospect" theory of the patent system—analogizing from the U.S. mineral claims system.[11] This theory has been highly controversial and criticized by various commentators, including those supporting classical theories.[12] In 1990, Merges and Nelson presented a new theory of the patent system, designated the "race-to-invent" theory, based upon empirical studies that society would benefit from granting patents with a relatively narrow scope of protection so as to permit competition in improvement inventions (innovations) to enhance the rapidity of development.[13] The most recent theory advanced by Grady and Alexander is a micro theory (i.e., predictive of individual patent cases) based upon "rent dissipation" theory.[14] The essence of this theory is that patents should minimize rent

7 Mark F. Grady & Jay I. Alexander, *Patent Law and Rent Dissipation*, 78 VA. L. REV. 305 (1992); Kevin Rhodes, Comment, *The Federal Circuit's Patent Nonobvious Standards: Theoretical Perspectives on Recent Doctrinal Changes*, 85 Nw. U. L. REV. 1051 (1991).

8 *See* LEDERMAN & TERESI, *supra* note 1, at 102-03, 154-75.

9 *See* PENROSE, supra note 6, at 21-31; Machlup, *supra* note 6, at 21-24. *See infra* text accompanying notes 46-48. The reward theory also has an economic basis. *See* WARD S. BOWMAN JR., PATENT ANTITRUST LAW: A LEGAL AND ECONOMIC APPRAISAL 30-32, 38-40 (1971) (citing FRANK H. KNIGHT, RISK, UNCERTAINTY AND PROFIT (1957); *An Answer to, Is Group Choice a Part of Economics?*, 67 Q.J. ECON. 608 (1953)); *infra* text accompanying notes 49-60.

10 *See* FREDERIC M. SCHERER, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE ch. 16 (2d ed. 1980) [hereinafter SCHERER, INDUSTRIAL]; Alfred E. Kahn, *The Role of Patents, in Competition, Cartels and Their Regulation* 308 (John P. Miller ed., 1962); Douglas F. Greer, *The Case Against Patent Systems in Less-Developed Countries*, 8 J. INT'L L. & ECON. 223 (1973); A. Samuel Oddi, *Beyond Obviousness: Invention Protection in the Twenty-First Century*, 38 Am. U. L. REV. 1097, 1101-02, 1114-16 (1989) [hereinafter Oddi, *Beyond Obviousness*]; A. Samuel Oddi, *An Uneasier Case for Copyright than for Patent Protection of Computer Programs*, 72 NEB. L. REV. 351 (1993) [hereinafter Oddi, *Uneasier Case*]; A. Samuel Oddi, *The International Patent System and Third World Development: Reality or Myth?* 1987 DUKE L.J. 831 [hereinafter Oddi, *International Patent System*].

11 Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265 (1977) [hereinafter Kitch, *Nature and Function*].

12 *See* Roger L. Beck, *The Prospect Theory of the Patent System and Unproductive Competition*, *in* 5 RESEARCH IN LAW AND ECONOMICS 193 (Richard O. Zerbe, Jr. ed., 1983); Grady & Alexander, *supra* note 7, at 313-16; Donald G. McFetridge & Douglas A. Smith, *Patents, Prospects, and Economic Surplus: A Comment*, 23 J.L. & ECON. 197 (1980); Oddi, *Beyond Obviousness*, *supra* note 10, at 1110-12; SCHERER, INDUSTRIAL, *supra* note 10, at 476-77 & n. 3 (citing Robert J. Gordon, *The Incidence of the Corporation Income Tax*, 57 AM. ECON. REV. 751 (1967)).

13 Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839 (1990); *see also* Robert P. Merges, *Commercial Success and Patent Standards: Economic Perspectives on Innovation*, 76 CAL. L. REV. 803 (1988).

14 Grady & Alexander, *supra* note 7; Rhodes, *supra* note 7. On rent theory generally, *see* TOWARD A THEORY OF THE RENT-SEEKING SOCIETY (James M. Buchanan et al. eds., 1980) (considering the theory, measurement and applications of rent-seeking). Judge Posner defines "rent-seeking" as "the incentive to overproduce goods that promise a return greater than the cost of production (that is, an economic 'rent'), and to the resulting waste when rents are transformed, through competition to obtain them, into costs." RICHARD A. POSNER, LAW AND LITERATURE 342 (1988); RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 37-38 (4d ed. 1992) (analyzing the costs of such behavior) [hereinafter POSNER, ECONOMIC ANALYSIS].

dissipation at the invention (conception) and innovation (improvement) stages.[15] Accordingly, the theory may be used to predict the outcome of individual patent cases, with a particular patent being enforced if overall rent dissipation is avoided.[16]

The analogy between physics and patent economic theory, however, breaks down at the most fundamental level. Both classical and quantum mechanics are scientifically verifiable. Newton's laws still work quite nicely, provided one does not travel too fast, as does Einstein's general theory of relativity, provided one does not stray into the subatomic universe.[17] Unfortunately, neither classical nor modern patent economic theory is verifiable. At the present state of knowledge, macro theories must be based on assumptions concerning societal outcomes. There is no general agreement that any of the macro theories of the overall patent system can rigorously demonstrate that a patent system provides a net societal benefit.[18] The extrapolation from macro to micro theory may be especially unrewarding when applied in the unmeasurable universe of actual patent cases. The objective difficulty of evaluating factual situations and doctrinal applications in actual patent cases may be analogized to the "uncertainty principle" in physics. Broadly stated, the uncertainty principle recognizes that, because of the physical nature of light and particles, it is impossible to measure speed and position with exacting certainty; thus quantum mechanics predicts probability of outcome rather than actual outcome.[19] One would hope for similar qualifications in any predictive economic theory of outcome in actual patent cases. Nonetheless, if any of the economic theories

15 Grady and Alexander indicate a third possible source of rent dissipation due to maintaining the secrecy of inventions rather than relying upon the patent system for protection. Grady & Alexander, *supra* note 7, at 308-09. Economists employ the term "innovation" to define the technological developments that follow from a basic invention and that are actually commercialized:

> The terms "invention" and "innovation" suggest the conceptual formulations of Abbott Payson Usher and Joseph A. Schumpeter. Crucial to Usher's conception of invention is an "act of insight" going beyond the exercise of normal technical skill, even though additional activities (perception of a problem, setting the stage, and critical revision) are also recognized. Schumpeter, on the other hand, defined innovation as "the carrying out of new combinations." For the case of new technology this can be identified with reducing an invention to practice and exploiting it commercially.

FREDERIC M. SCHERER, INNOVATION AND GROWTH 8 (1984) (footnotes omitted). Patent attorneys, however, tend to talk in terms of improvement inventions or patents, which improve upon a basic invention or patent. For the purposes of this Article, the terms innovation and improvement invention or patent will be used interchangeably, with the understanding that the improvement invention or patent has been commercialized.

16 Grady & Alexander, *supra* note 7, at 309.

17 *See* HAWKING, *supra* note 1, at 10, 13.

18 Machlup concludes from his study:

> If we did not have a patent system, it would be irresponsible, on the basis of our present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible on the basis of our present knowledge, to recommend abolishing it.

Machlup, *supra* note 6, at 80; *see also* Oddi, *International Patent System*, *supra* note 10, at 832 n.2 (collecting studies). Indeed, Grady and Alexander state that "rent dissipation would be a much smaller problem" if there were no patent system, but that the nature of their theory permits them "to be agnostic about whether patent rewards are a good idea." Grady & Alexander, *supra* note 7, at 309-10; *see also id.* at 317.

19 HAWKING, *supra* note 1, at 55-61. Upon learning of the inherent randomness of quantum mechanics, Albert Einstein expressed his objection: "God does not play dice." *Id.* at 56; *see also* LEDERMAN, *supra* note 1, at 175-88.

is capable of predicting the outcome of individual cases in terms of efficiency, it would seem to follow that the overall system would also result in a net benefit. Could this then be the "Holy Grail" of patent economic theory? This Article concludes that none of the theories is consistently predictive of case outcomes, in particular the rent dissipation theory, which is the only theory that claims predictability in actual cases. Thus, the overall conclusion is that currently there is no unifying theory that describes the overall patent system and the outcome of individual cases.

To reach this conclusion, a framework for evaluating the various theories is developed in Part II of the Article, the various classical and modern theories are briefly discussed and critiqued in Part III A and B, the characteristic outcomes predicted by the various theories are identified in Part III C, and the theories are applied to various actual cases to test their respective predictive powers in Part IV.

The conclusion that no unifying theory has yet been presented is not intended to diminish the quest for theories, economic and otherwise, for explaining the patent system at both the macro and micro levels; nonetheless, any unifying theory of patents is apt to prove even more elusive than the unifying theory in science.[20]

II. FRAMEWORK FOR EVALUATION

To evaluate whether an economic theory predicts the outcome of actual patent litigation, some framework for that evaluation is necessary. In the first instance, one would expect the economic theory to be consistent with the patent statute, its substance and procedure.[21] Nonetheless, because of the broad statutory language establishing basic principles of patent law, courts have a great deal of flexibility in construing the statute. A fundamental issue with respect to the grant of a patent is the "protectability" of the invention. The sine qua non for the patent grant is that the invention must fall with the statutory classes of invention (viz. "process, machine, manufacture, or composition of matter") and must be "useful" (i.e., possess "utility" in the commercial sense).[22] The two basic issues in patent litigation are: validity (Does the invention as claimed meet the con-

20 *See* WEINBERG, *supra* note 1, at 4-6 (discussing importance of the Supercollider and its importance to finding a unifying theory); *see also* LEDERMAN, *supra* note 1, at 378-81. Congress terminated the Supercollider project in October, 1993, rendering a severe blow to the advancement of particle physics. E. Michael Myers, *Burial Services for Texas Supercollider*, UPI, Oct. 26, 1993, *available in* WESTLAW, UPI database. Nonetheless, evidence of the elusive "top" quark was reported by physicists working at Fermi National Accelerator Laboratory in April, 1994. The top quark, along with the up, down, charm, stranger and bottom quarks, constitute the basic building blocks of matter according to the Standard model. J. Madeleine Nash, *Gotcha!*, TIME, May 9, 1994, at 69; *Fermilab Finds Evidence of Elusive Top Quark*, NUCLEAR NEWS, June 1994, at 74; *cf.* George L. Priest, *What Economists Can Tell Lawyers About Intellectual Property: Comment on Cheung*, *in* 8 RESEARCH IN LAW AND ECONOMICS 19, 19 (John Palmer & Richard O. Zerbe, Jr. eds., 1986) ("The ratio of empirical demonstration to assumption in [patent economic] literature must be very close to zero.").

21 35 U.S.C. §§ 1-376 (1988 & Supp. V 1993).

22 35 U.S.C. §101 (1988 & Supp. V 1993) provides: "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefore, subject to the conditions and requirements of this title."

ditions (standard) for protection?)[23] and infringement (Does the accessed subject matter fall within scope of protection of the patent?).[24] An invalid patent, of course, cannot be infringed. The value of predictability is not limited solely to the validity issue. A unified comprehensive theory would also be expected to predict infringement.

A. Protectability

The issue of protectability is more likely to be addressed at the grant stage rather than in litigation for a particular invention. Nonetheless, whether a patent is granted or sustained will depend upon whether a broad or narrow interpretation is given to statutory subject matter and to the utility requirement. Protectability tends to affect primarily inventions of a fundamental nature at an early stage of development.[25] Thus, a theory positing a broad interpretation of statutory subject matter and utility will predict the protection of such inventions, while a theory positing a narrow interpretation would tend to exclude them.

B. Conditions for Protection

A determination of the validity of a patent by a court is an ex post determination that the claimed invention complied ex ante with the conditions for protection. The essential substantive conditions to sustain the patent are that the invention claimed be novel (according to 35 U.S.C. § 102)[26] and, moreover, not be obvious to one skilled in the particular field of that invention (according to 35 U.S.C. § 103).[27] A particular theory may posit a high standard for the grant of a patent, thereby predicting a higher probability that a particular patent will be held invalid in litigation. Conversely, a theory may posit a low standard for protection, thereby predicting a higher probability that a particular patent will be held valid.

C. Scope of Protection

The scope of protection is defined by the claims of the patent as supported by the patent disclosure, which must enable a person skilled in the art to practice the claimed invention.[28] Literal infringement defines the primary scope of protection, i.e., a patent claim may be literally read ele-

23 The conditions for protection are defined in 35 U.S.C. §§ 102 & 103 (1988) (quoted *infra* notes 256, 286, respectively).

24 The conduct that constitutes infringement is specified in 35 U.S.C. § 271 (quoted *infra* notes 239, 313, 316, 336, 337, 340).

25 *See* Oddi, *Beyond Obviousness*, *supra* note 10, at 1117-20; *infra* text accompanying notes 249-55 (further discussing the impact of narrow construction of 35 U.S.C. § 101 on basic inventions).

26 35 U.S.C. § 102 (quoted *infra* note 256).

27 35 U.S.C. § 103 (quoted *infra* note 286).

28 Section 112 imposes the "enabling" requirement of disclosure:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

35 U.S.C. § 112 (1988 & Supp. V 1993).

ment-by-element upon an accused subject matter.[29] The scope of protection may be augmented by nonliteral infringement, particularly by the doctrines of equivalents[30] and contributory[31] and induced[32] infringement. A theory that posits a broad scope of infringement (literal and nonliteral) would predict infringement more probably than a theory positing a narrow scope of protection.

D. Predictability of Outcomes

Predictability of outcomes in actual patent litigation would thus be a function of how the theory posits the conditions for protection (low to high) and the scope of protection (broad to narrow), presuming statutory subject matter and utility requirements of protectability have been met. A theory that posits a low standard for protection and a broad scope of protection will predict more cases of validity and infringement than a theory that posits a high standard for protection and a narrow scope of protection.

Predictability of outcome may also depend upon whether protectability, the conditions for protection, and the scope of protection vary as a function of the type of invention claimed in the patent. Thus, a theory that posits a narrow definition of statutory subject matter and utility may bar certain basic inventions from protection. A theory that posits a high standard for protection and broad scope of protection for basic inventions (compared to detail inventions) may be expected to predict a higher probability of validity and infringement of basic compared to detail inventions.

III. THE THEORIES

In this section, the various patent economic theories will be briefly described and critiqued and their respective predictive characteristics identified with respect to the following: a broad or narrow interpretation of protectability, a high or low standard for protection, a broad or narrow scope of protection, and variations of the standard or scope according to the categorization of invention.

A. Classical Theories

The classical theories of the patent system may be subdivided into two categories: natural law/justice based theories and economic/public policy-based theories. The natural law/justice based theories may be subdivided into the "natural property rights" or "natural-law" theory[33] and the "reward for services rendered" or "reward by monopoly" theory[34] (collectively the "reward" theory).

29 *See infra* text accompanying notes 314-29 (discussing literal infringement).
30 *See infra* text accompanying notes 330-35 (discussing doctrine of equivalents).
31 35 U.S.C. § 271(c) (quoted *infra* note 337).
32 35 U.S.C. § 271(b) (quoted *infra* note 336).
33 *See* PENROSE, *supra* note 6, at 19-26; Machlup, *supra* note 6, at 21-22.
34 *See* PENROSE, *supra* note 6, at 26-31; Machlup, *supra* note 6, at 21, 23.

The natural property rights theory is based upon the premise that inventors inherently have the property right in their inventions and that, in justice, society must recognize that right.[35] In essence, the right to have one's inventions protected is one of those "rights of man."[36] This theory has not received much attention in the modern era, because, perhaps, of the relative demise of natural law jurisprudence[37] and thus will not be separately addressed in this Article.

The reward theory continues to have vitality in the modern era and will be addressed in detail below.[38] Briefly, the rationale of this theory is that an inventor has a natural right to receive a reward for providing an invention to society, and that reward should be in the form of a monopoly and commensurate with the usefulness to society of the proffered invention. This theory is justice based in the sense that society is considered to be morally obligated under natural law theory to grant the reward;[39] yet it is also based on an economic premise that the "just" monopoly reward provided is (or should be) proportional to the benefit received by society.

The economic or policy based theories may be subdivided into the "disclosure of secrets" or "exchange for secrets" theory[40] and the "encouragement of invention" or "monopoly profit incentive" theory.[41] The latter theory will be designated herein as the "patent-induced" theory as more aptly descriptive of it. The patent-induced theory will be considered in detail below.[42] Briefly, the essence of this theory is that patents should be offered in order to induce an adequate number of inventions for society and that, on balance, the benefits derived from inducing inventions exceed the costs of protecting inventions by the patent monopoly.[43]

The disclosure of, or exchange for, secrecy theory will not be considered separately below, for it is the patent system that may provide the inducement for inventors to disclose their inventions to the public rather

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35 *See* PENROSE, *supra* note 6, at 21; Machlup, *supra* note 6, at 22.

36 This thesis is expressly adapted in the preamble of the French Patent statute of 1791:

> That every novel idea whose realization or development can become useful to society belong primarily to him who conceived it, and that it would be violation of the rights of man in their very essence if an industrial invention were not regarded as the property of its creator.

Quoted in Machlup, *supra* note 6, at 22.

37 "The natural law tradition is not one that has generated much enthusiasm in the contemporary world outside of Roman Catholic circles." GEORGE C. CHRISTIE, JURISPRUDENCE 78 (1973).

38 *See infra* text accompanying notes 45-63.

39 *See* PENROSE, *supra* note 6, at 26; Machlup, *supra* note 6, at 23.

40 *See* PENROSE, *supra* note 6, at 31-34; Machlup, *supra* note 6, at 21, 24-25.

41 *See* PENROSE, *supra* note 6, at 34-39; Machlup, *supra* note 6, at 21, 23-24.

42 *See infra* notes accompanying notes 64-90.

43 *See* SCHERER, INDUSTRIAL, *supra* note 10, at 443 (emphasis added):

> [E]xcept when innovators' profits come largely from cannibalization of the profits that would otherwise be enjoyed by the producers of substitute products, it is likely that society as a whole (i.e., including both consumers and producers) gains from inventions and innovations *induced or hastened* by the grant of patent rights.

Id.; see also Greer, *supra* note 10, at 224 ("Nevertheless, it can be formally demonstrated that the economic benefits of such inventions (in the form of production cost saving or new product consumption utilities) always exceed those social costs to yield a net social benefit.") (footnotes omitted); KAHN, *supra* note 10, at 311 ("So long as the innovation would not have been forthcoming without the patent, this social cost must always be less than the benefit; but of course the converse is equally true.").

than relying upon secrecy. However, because secrecy may be a reasonable alternative to patent disclosure, the potential for secrecy will be considered in the analysis of the predictability of various theories at appropriate places in the Article.[44]

1. Reward Theory

The reward theory, as any other theory based upon natural law, suffers from the necessity of accepting as a matter of faith that property is a natural right rather than a creation of society.[45] The theory further suffers from requiring its extension to intangible property in the form of the exclusivity granted by a patent and from the fact that an invention is an inexhaustible form of property; hence, its value to society should increase with its use. This brings into play the economic hypothesis upon which the reward theory is based, as stated by Penrose:

> The more widely a good can be used, the greater, surely, is its total usefulness. To limit its use is to limit its usefulness, although this may, at the same time, give it an economic value. This is, of course, a restatement of the famous paradox of value, but so far as inventions are concerned a price is put on them not because they are scarce but in order to make them scarce to those who want to use them.[46]

Reward to the inventor thus depends upon commercial success and the ability to restrict output by monopoly pricing. In other words, for an inventor to reap a reward, it is necessary that the invention be commercialized. Because of the finite term of a patent, those inventions that may be ahead of their time may not be rewarded commensuratively to their contribution to society, while those inventions that may be easily commercialized may be excessively rewarded considering the relatively trivial contribution made.[47]

While it may not be possible to demonstrate rigorously that the reward theory satisfies principles of justice and achieves a net-beneficial economic outcome, it may still serve as some guide to predicting the outcome of actual patent litigation. It may, at least, offer a partial theory of the patent system.

Bowman supports the reward theory on purely economic grounds to prevent "free riding" by copyists;[48] however, he maintains that the reward system should be consumer oriented and that a relatively high standard of patentability should be imposed to prevent the routinizer from obtaining excessive rewards.[49] The rationale for the consumer-oriented system is that the marketplace is a better determiner of usefulness of inventions than

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44 In addition, under rent dissipation theory, rent may be dissipated by reliance upon secrecy rather than on patents. *See* Grady & Alexander, *supra* note 7, at 305-08, 342.

45 *See* PENROSE, *supra* note 6, at 22.

46 *Id.*

47 "One man may spend his life developing a great idea for which society is not ready; another may perfect a bright idea in an evening for a clever gadget which society is willing to buy in large quantities and pay millions of dollars for." *Id.* at 30-31.

48 BOWMAN, *supra* note 9, at 32.

49 *Id.* at 34.

other means, such as, offering direct subsidies or limiting protection to high cost inventions.[50]

Kitch does not question the reward theory "on its own terms" but argues that it "offers an incomplete view of the functions of the patent system."[51] He defines the reward theory as: "The conventional view of the patent system as a device that enables an inventor to capture the returns from his investment in the invention . . . ."[52] According to Kitch, the reward theory provides an incomplete view because it assumes a negatively sloped demand curve, i.e., a monopoly condition for the patent owner.[53] The prospect theory, on the other hand, assumes a horizontal demand curve, i.e. a competitive situation, in the vast majority of cases.[54] The prospect theory will be considered in detail below.[55]

The reward theory continues to have some vitality in the modern era. Rhodes employs the reward theory to illustrate that it is being followed by the Supreme Court in its patentability decisions.[56] He isolates two doctrines bearing upon the nonobviousness issue, namely, "synergism" and "commercial success."[57] He concludes, because the reward theory is primarily concerned about the costs of rewarding all inventions, that a high standard of patentability is suggested, including the synergism requirement, and that secondary considerations, such as commercial success, would not be an important consideration in determining nonobviousness.[58] In contrast, Rhodes concludes that Kitch's prospect theory better explains the decisions of the Court of Appeals for the Federal Circuit, which reject the doctrine of synergism and heavily rely upon commercial success as indicative of nonobviousness.[59]

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50 *Id.* at 38, 47.

51 Kitch, *Nature and Function*, *supra* note 11, at 266.

52 *Id.*

53 *Id.* at 274.

54 *Id.*

55 *See infra* text accompanying notes 91-103.

56 Rhodes, *supra* note 7, at 1053.

57 *Id.* In Graham v. John Deere Co., 383 U.S. 1, 17-18 (1966), the seminal case interpreting the nonobviousness standard of "invention" under 35 U.S.C. § 103, the Court stated: "Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy." The so-called synergism requirement was later applied by the Supreme Court as a gloss on the nonobviousness standard of § 103 in two cases involving combination patents — Anderson's-Black Rock, Inc. v. Pavement Salvage Co., 396 U.S. 57 (1969) (the combination of mounting a radiant heater in a conventional asphalt paving machine) and Sakraida v. Ag Pro, Inc., 425 U.S. 273 (1976) (combination of old elements for flushing manure from a barn floor). In *Sakraida*, the Court concluded: "We cannot agree that the combination of these old elements to produce an abrupt release of water directly on the barn floor from storage tanks or pools can properly be characterized as synergistic," that is, 'result[ing] in an effect greater than the sum of the several effects taken separately.'" *Id.* at 282 (quoting *Anderson's-Black Rock*, 396 U.S. at 61). In neither case did the commercial success of the inventions convince the Court of their nonobviousness.

58 Rhodes, *supra* note 7, at 1080.

59 *Id.* at 1094-95. In Chore-Time Equip., Inc. v. Cumberland Corp., 713 F.2d 774, 781 (Fed. Cir. 1983), the court considered a synergism request "unnecessary and confusing." In Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530 (Fed. Cir. 1983), the court indicated there was no separate category of "combination patents." *Id.* at 1540. In addition, the court suggested that district courts must take into account secondary considerations on the issues of nonobviousness. *Id.* at 1538-39.

Grady and Alexander maintain they are "agnostic about whether patent rewards are a good idea."[60] In line with their rent dissipation theory, the reward theory is not rejected outright but reduced to what they call the "weak version"—to the effect that patents are intended to reward and thus stimulate inventive activity.[61] Indeed, they find that the reward theory has considerable predictive power over many types of cases. The significant shortcoming of the reward theory, in their view, is in explaining why, what they term, "elegant" inventions (i.e., inventions that are not improvable) are not protected.[62] The rent dissipation theory will be discussed in detail below.[63]

2. Patent-Induced Theory

The patent-induced theory is an economic based theory that posits generally that if patents were only granted on inventions induced by the patent system, this would result in a net benefit to society.[64] Under this theory, the monopoly reward of a patent would only be granted to inventors whose inventions were actually induced by the patent system. A causal relationship is required between the availability of the patent system and the creation of the invention: *But for* the patent system the invention would not have been made available to be public.[65] The primary difference between the patent-induced theory and the reward theory is that the former would reward only those patents induced by the patent system, while the latter would reward all inventions regardless of what motivated the inventor to create them. The patent-induced theory thus would eliminate from protection those inventions, induced by other than the patent system, such as those induced by the market, scientific curiosity, or accident.[66] Protecting such nonpatent-induced inventions by patents is costly to society because such inventions would be provided free of the patent monopoly. The patent-induced theory is thus a much narrower theory than the reward theory; however, it does incorporate the reward aspect of the reward theory, but would limit the reward of a patent to inventions induced by the patent system.[67]

Perhaps the best modern statement of the interrelationship of the reward to stimulate invention and the benefit to society is found in *Graham v.*

60 Grady & Alexander, *supra* note 7, at 309-10.

61 *Id.* at 312. They elevate what is called the patent-induced theory here to the "strong version" of the reward theory. "The strong version of reward theory, as advanced in the works of Frederic Scherer and, more recently, A. Samuel Oddi, posits that rewards should explain actual patent decisions." Grady & Alexander, *supra* note 7, at 312-13 (notes omitted). This usage is questioned, as is the assertion that the patent-induced theory has been advanced to "explain actual patent decisions."

62 Grady & Alexander, *supra* note 7, at 326-27.

63 *See infra* text accompanying notes 114-28.

64 *See supra* note 43.

65 "Induced" is used in a broad sense to indicate that the patent system may induce inventions at all stages of the creative process, from conception through improvement (commercialization) and related applications and by providing an alternative to protection by secrecy. *See* Oddi, *Uneasier Case*, *supra* note 10, at 374-75.

66 *See* SCHERER, INDUSTRIAL, *supra* note 10, at 444-47.

67 In this context, the patent-induced theory would be better characterized as the "narrow version" of the reward theory rather than the "strong version."

John Deere Co.,[68] the seminal case interpreting the nonobviousness standard for patentability codified in § 103 of the 1952 Patent Act: "The inherent problem was to develop some means of weeding out those inventions which would not be disclosed or devised but for the inducement of a patent."[69] Thus, *Graham* provides a doctrinal basis for the patent-induced theory in addition to its economic one.[70] The nonobviousness standard as articulated in *Graham* provides one means of separating patent-induced from nonpatent-induced inventions;[71] however, no means are provided for eliminating the economic costs associating with inventions that can satisfy the nonobviousness standard but still would have been invented without a patent system; in particular, market-induced inventions.

A major contribution to the patent-induced theory was made by Frederic W. Scherer, who developed a topology of inventions based on the costs and benefits of investing in the development of various categories of inventions as predictive of whether the patent system was needed to induce that investment.[72] "Revolutionary inventions" are defined as those that produce a genuine revolution in consumption or production.[73] Basic inventions of

68 383 U.S. 1 (1965).

69 *Id.* at 11.

70 In Roberts v. Sears, Roebuck & Co., 723 F.2d 1324 (7th Cir. 1983) (en banc), Judge Posner was unable to convince the full court to vigorously apply the patent-induced rationale of *Graham*. The court, rehearing this case en banc, refused to hold Roberts' patent on a "quick release socket wrench" invalid as a matter of law, as Judge Posner had in his opinion in the original appeal. 697 F.2d 796 (7th Cir. 1983), *vacated and reh'g granted*, 723 F.2d 1324 (7th Cir. 1983). Instead, the full court remanded for a new trial because the jury had been permitted to be the final arbiter of obviousness. In his concurring and dissenting opinion, Judge Posner concluded that the standard for obviousness should be: "[I]f a court thinks an invention for which a patent is being sought would have been made as soon or almost as soon as it was made even if there were no patent laws, then it must pronounce the invention obvious and the patent invalid." *Roberts*, 723 F.2d at 1346 (Posner, J., concurring and dissenting). He later commented: "I know that many lawyers and judges find the language of economics repulsive. Yet the policies that have given shape to the patent statute are quintessentially economic, and the language of economics is therefore the natural language in which to articulate the test for obviousness." *Id.* at 1347.

71 In *Graham*, the determination of whether an invention is obvious is made by determining the scope and content of the prior art, ascertaining differences between the prior art and the claims at issue, and resolving the level of ordinary skill in the art. *Graham*, 383 U.S. at 17. The economic logic is that, if the obviousness standard provides a suitable "weeding" mechanism for identifying those inventions that the public would have received without the patent incentive, society will not have to bear the costs of noninduced patents. *See infra* text accompanying notes 287-305 (further discussing *Graham*).

72 SCHERER, INDUSTRIAL, *supra* note 10, at 443-50.

73 As stated by Scherer:

> [I]t is conceivable that without a patent system certain spectacular technical contributions—those effecting a genuine revolution in production or consumption patterns—might be lost or (more plausibly) seriously delayed because their support lends itself poorly to rational benefit/cost calculation. Such innovations may lie off the beaten paths of industrial technology, where no firm or group of companies has a natural advantage; and the innovator may be forced to develop completely new marketing channels and production facilities to exploit them. They may entail greater technological and market uncertainties, higher development costs, and longer inception-to-commercialization lags than the vast bulk of all industrial innovation.

Id. at 448. Scherer would categorize black and white television and xerography as revolutionary. *Id.* To these may be added numerous other inventions, including, but obviously not limited to, the airplane, antibiotics, instant photography, lasers, synthetic textiles, tranquilizers, sulfonamides, telegraph, telephone, and transistors. *See* S. GEE, TECHNOLOGY TRANSFER, INNOVATION, AND INTERNATIONAL COMPETITION 161 (1981); UNITED STATES PATENT OFFICE, REVOLUTIONARY IDEAS—PATENTS & PROGRESS IN AMERICA (1976).

the revolutionary type have an uncertain benefit/cost ratio and, thus, are theorized to depend upon the patent system for their creation because of this uncertainty in investment.[74] According to Scherer, revolutionary inventions form the important category of patent-induced inventions in the sense that, without the inducement provided by the patent system, it is likely that society would be denied the benefits or have those benefits seriously delayed but for the patent system.[75]

Another category of inventions defined by Scherer is the high benefit/cost ratio invention, which predictably provides high benefits to the investor at relatively low cost.[76] These tend to be inventions that are market-induced by the competitive forces to stay ahead of competition with respect to subject matter within the investor's normal market area. Such inventions may be categorized as nonpatent-induced in the sense that there is a strong likelihood that these inventions would be created without a patent system due to market forces and the incentives provided by lead time, learning curve advantage and market recognition.[77] Also, inventions that are discovered by accident or by serendipity may be categorized as being high benefit/cost inventions, as they are fortuitously created rather than resulting from an investment in a particular type of solution.[78]

A final category of inventions identified by Scherer that would appear to be dependent on the inducement of the patent system is the low benefit/cost ratio invention.[79] These inventions typically are detail inventions in markets where there is a high degree of competition. Thus, these inventions would have a relatively horizontal demand curve compared to a downwardly sloping demand curve usually predicted for patented inventions. These inventions would be categorized as patent-induced in the sense that there would be little incentive to produce them in a highly competitive market if the improvement could be immediately copied.[80]

The present author, believing that revolutionary inventions are economically important, producing significant social benefits, has proposed the adoption of a "revolutionary patent" in an attempt to provide an ade-

74 SCHERER, INDUSTRIAL, *supra* note 10, at 448.

75 *Id.*

76 *Id.* at 443-48.

77 *Id.* at 444-46; *see also* Oddi, *International Patent System*, *supra* note 10, at 838-39; Oddi, *Beyond Obviousness*, *supra* note 10, at 1114-16. Classic examples of high benefit/cost inventions may include: the pencil with eraser attached (*see* Reckendorfer v. Faber, 92 U.S. 347 (1876), and Rubbertip Pencil Co. v. Howard, 87 U.S. (20 Wall.) 498 (1874) (discussed *infra* text accompanying notes 191-96)); the "quick release socket wrench" (*see* Roberts v. Sears, Roebuck & Co., 723 F.2d 1324 (7th Cir. 1983) (en banc) (discussed *supra* note 70 and *infra* note 247)).

78 *See* Oddi, *Beyond Obviousness*, *supra* note 10, at 1115-16 & n.113 (giving examples of serendipitous inventions, including x-rays, penicillin, vulcanization of rubber, dynamite, and TEFLON).

79 SCHERER, INDUSTRIAL, *supra* note 10, at 448. Examples of low benefit/cost inventions may be another mousetrap, can opener, or bottle cap.

80 *Id.* Scherer concludes that society would lose little if such inventions were not created because of the elimination of the patent system. *Id. But see* Kitch, *Nature and Function*, *supra* note 11, at 289 (considering such low benefit/cost inventions to be the important class, concluding that if the prospect function is taken into account, patents that have little value to their owners may still perform useful social functions). The rent dissipation theory may have led Grady and Alexander to the same conclusion—that patents having little value but signalling improvements are the most likely to be protected. Grady & Alexander, *supra* note 7, at 320.

quate incentive for the creation of such inventions.[81] The argument is made that the present patent system inadequately induces such inventions and that, in fact, the present system discriminates against them because of limiting interpretations of statutory subject matter and the utility requirements for invention, which have a disparate impact on revolutionary inventions.[82] Because of the inherent difficulty of separating patent-induced from nonpatent-induced inventions, it was proposed that the grant of a revolutionary patent would require an enhanced standard for protection, which was proposed to be "extraordinary to experts" in the relevant art and would take into account technical, commercial and investment factors in that evaluation to further insure that the particular invention clearly is one of revolutionary character.[83] The intent of such a high standard would be to eliminate high benefit/cost inventions from this title of protection, because such inventions are deemed to be costly to society, as they generally would be induced by the market without the benefit of the patent system.

Two principle criticisms have been leveled at the patent-induced theory. The first is that it discriminates against low cost (high benefit/cost) inventions and hence promotes wastefulness.[84] This, of course, would be true if the patent system actually made it more difficult for low cost inventions to receive patents than for other inventions. The patent system provides no means for preventing such low cost inventions from being patented, provided that they meet the standard for patentability of being new, useful, and nonobvious. Quite to the contrary, it is revolutionary inventions that would appear to be discriminated against, in the sense that such inventions are more apt to be precluded by doctrinal interpretations of the utility and statutory classes of invention. Bowman is indeed correct that wastefulness would be promoted if some sort of utility rate-making system were implemented to determine patentability, with those inventions having high cost being given preference.[85] The reason for protecting revolutionary inventions as a preferred class is that the uncertainty of the benefit/cost ratio creates a significant risk in investing in such inventions. Moreover, distinguishing between revolutionary inventions and high benefit/cost inventions can often be done on a basis other than the cost of developing an invention.[86]

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81 Oddi, *Beyond Obviousness*, *supra* note 10.

82 *Id.* at 1117-20, 1127-30.

83 *Id.* at 1131-37.

84 BOWMAN, *supra* note 9, at 39-42; Kitch, *Nature and Function*, *supra* note 11, at 280-82; Grady & Alexander, *supra* note 7, at 312-14.

85 BOWMAN, *supra* note 9, at 41.

86 Bowman illustrates the difficulty of "cost finding" in the creation of invention by the TEFLON example. BOWMAN, *supra* note 9, at 39 n.8. TEFLON was accidentally discovered, was admittedly nonobvious and reaped a huge reward for Du Pont. Thus, it may be clear that the invention of TEFLON was not patent-induced; however, was its commercialization induced by the patent system or the market? Would Du Pont have abandoned further work on TEFLON if it could not have gotten a patent? Would it have relied upon secrecy and still have marketed it? POST-IT NOTES is given by Grady and Alexander as an example of a product that was serendipitously discovered, "revolutionized" its field, and yet was per se unpatentable (presumably because it was obvious). Grady & Alexander, *supra* note 7, at 344. It would appear that it would cost 3M significantly less to develop this product than TEFLON. Were head start, product recognition, and established marketing channel sufficient incentives?

The second criticism of the patent-induced theory is that it "simply fails to explain the cases."[87] This is a peculiar criticism, because it is not apparent that any proponent of this theory has asserted that it does explain individual cases.[88] The patent-induced theory is a macro theory intended to explain the overall patent system and to predict the overall value of the patent system based upon the ratio of patent-induced compared to nonpatent-induced inventions.[89] The higher the ratio the higher probability of societal benefit. The only conclusion to be drawn from the theory is that if patents were restricted to those inventions that are, in fact, induced by the patent system, then a net benefit would accrue to society.[90]

B. Post-Classical Theories

1. Prospect Theory

In a well-received article critiquing *Graham v. John Deere Co.*, Kitch embraced the patent-induced theory, agreeing that obvious inventions should not be protected as they would be forthcoming even in the absence of a patent system.[91] However, a decade later, he recanted and offered, instead, the prospect theory.[92] Kitch defines a "prospect" to be "a particular opportunity to develop a known technological possibility."[93] He analogizes the patent system to the U.S. mineral claims system, which, he concluded, did not result in underutilization.[94] Thus, Kitch argues that the normal assumption of a negatively sloped demand curve should not be made; rather the demand curve should be substantially horizontal, indicating competition with the patented invention.[95]

In essence, according to Kitch, the patent right could be treated as any other property right. If a patent is treated as property, the patent owner would maintain control over the development of the invention, minimize transaction costs, remove any need for secrecy, and give notice to others of

87 Grady & Alexander, *supra* note 7, at 312-13.

88 As stated in Oddi, *Uneasier Case*, *supra* note 10, at 373-74 n.75: "It should also be made clear that, while it would be economically desirable for courts to uphold inventions and works of authorship that are induced by the respective systems compared to noninduced ones, factual differences and doctrinal concerns make this determination difficult in actual cases."

89 Accordingly, the higher the ratio of patent-induced to nonpatent-induced inventions, the higher the probability that a net benefit will occur to society because of the patent system.

90 *See supra* note 43.

91 Edmund W. Kitch, Graham v. John Deere Co., *New Standards for Patents*, 1966 SUP. CT. REV. 293 (1966). Kitch states:

> [T]wo premises ["innovation should be encouraged and patent monopolies represent a substantial cost to the consumer"] are accommodated by the basic principle on which the non-obviousness test is based: a patent should not be granted for an innovation unless the innovation would have been unlikely to have been developed absent the prospect of a patent.

Id. at 301.

92 Kitch's reappraisal appears to be based in large part because of Bowman's criticism that "cost finding" should not be focused on how the invention was made, for this would penalize low cost inventions. Kitch, *Nature and Function*, *supra* note 11, at 281-82; *see* BOWMAN, *supra* note 9, at 39-42.

93 Kitch, *Nature and Function*, *supra* note 11, at 266.

94 *Id.* at 274.

95 *Id.*

the discovery to prevent duplication of efforts.[96] Kitch also discards the nonobviousness standard for invention as being irrelevant to the prospect theory.[97] He would adopt a "substantial novelty" standard as being an "economically rational test of patentability."[98] The prospect theory thus would be tantamount to granting property status to technological information that is substantially novel at an early developmental stage. This would enable its owner to exert coordinating control over the future development of innovations based on that technological information.

The criticisms of the prospect theory are many. First, the assumption of a horizontal demand curve rather than a downwardly sloping one as the model for the patent system is strongly contested.[99] It is also urged that the empirical evidence does not support the theory.[100] In addition, because of the high incentive to be first and the minimum standard for protectability, there will be high rent dissipation at the conception stage for inventions, which may far overbalance the limitation of rent dissipation at the innovation stage.[101] Also, the reliance of the theory on commercial success of the invention for its patentability is unsubstantiated.[102] Finally, the prospect theory does not predict the outcome of actual cases.[103]

2. Race-to-Invent Theory

In 1990, Merges and Nelson proposed a "race-to-invent" theory to describe the patent system.[104] The underlying premise of this theory is "faster is better."[105] This premise is based upon research concluding that the number of inventions increases with research and development expenditures, productivity increases with the number of inventions, and economic well-being increases with productivity.[106] In addition, Merges and Nelson rely upon empirical studies that indicate that technological development has been arrested in industries where broad patent protection was granted,

96 *Id.* at 276-80.
97 *Id.* at 280-84.
98 *Id.*
99 In Edmund W. Kitch, *Patents: Monopolies or Property Rights*, *in* 8 RESEARCH IN LAW AND ECONOMICS 31 (John Palmer & Richard O. Zerbe, Jr. eds., 1986) [hereinafter Kitch, *Patents*], Kitch argues that it is the exceptional case where patents confer monopoly power, citing SCM Corp. v. Xerox Corp., 463 F. Supp. 983 (D. Conn. 1978), *aff'd*, 645 F.2d 1195 (2d Cir. 1981), as an example. Scherer, in a sharp response, states: "But Xerox as the classic example of monopoly-free patents? Neither theory nor evidence will support the leap." Frederic M. Scherer, *Comment on Edmund Kitch*, *in* 8 RESEARCH IN LAW AND ECONOMICS 51 (John Palmer & Richard O. Zerbe, Jr. eds., 1986).
100 *See* Beck, *supra* note 12, at 199-206 (challenging Kitch's interpretation of empirical evidence relating to the commercialization of inventions, and the scope of protection actually afforded by patents); *see also* Merges & Nelson, *supra* note 13, at 872.
101 *See* Grady & Alexander, *supra* note 7, at 317. In analyzing Kitch's theory, the authors point out that: "If new fields of technology promise high patent-rent returns, a rent- dissipating race to discover the first application may occur, especially if the patent laws afford overly broad protection." *Id.*; *see also* McFetridge & Smith, *supra* note 12, at 203 (prospect function does not assist market participants seeking to economize common property resources.).
102 *See* Merges, *supra* note 13, at 841-42.
103 Grady & Alexander, *supra* note 7, at 317.
104 Merges & Nelson, *supra* note 13, at 908.
105 *Id.* at 878. ("Our argument rests on a simple premise: when it comes to invention and innovation, faster is better.").
106 *Id.*

compared to more rapid development where there was rivalry in the development stage.[107]

Because broad protection inhibits competition in improvements, Merges and Nelson favor limiting the scope of patent protection so that inventors of significant improvements are placed in a strong bargaining position vis-a-vis the inventors of basic inventions.[108] Thus, by limiting the scope of protection there will be more rapid development in this particular technological area. This theory is the antithesis of the prospect theory, which would grant broad coordinating power over future development by the original inventor. Merges and Nelson refuse to accept the premise that central coordination is more efficient. Their conclusion is based upon empirical studies that indicate underdevelopment under central coordination and high transaction costs with respect to the licensing of inventions for further development.[109]

Anticipating that the race-to-invent theory would be considered anti-patent, Merges and Nelson disclaim this conclusion because the theory would only apply "to the broader claims of a small number of patents, primarily those on pioneering breakthroughs."[110] This is the antithesis of the patent-induced theory, which is premised on providing high incentives for the creation of revolutionary invention, where the cost/benefit analysis is uncertain. Indeed, one may question why a patent system is needed at all in a patent system governed by the race-to-invent theory. It would seem that market-induced incentives, such as lead time, market recognition, and learning curve advantages, would provide adequate incentives for racing inventions to the market place. Moreover, secrecy would become highly important to protect investment in inventions, resulting perhaps in over-investment in secrecy and excess rent dissipation.[111] A great deal of rent dissipation would also occur in the competition to provide improvements on a basic invention. Such a system may encourage United States' inventors to sit back and wait for basic inventions to be developed by foreigners, and then immediately race to improve them.[112] One final criticism would be that the race-to-invent theory lacks predictive value, particularly where broad protection has been afforded to pioneering inventions.[113]

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107 *Id.* at 877, 884-908 (analyzing electrical lighting industry, automobiles and airplanes, radio, semiconductors and computers, chemical industries and science-based industries).

108 *Id.* at 876.

109 *Id.* at 872-77.

110 *Id.* at 916.

111 See Grady & Alexander, *supra* note 7, at 318 ("Secrecy measures may protect the private reward for innovation, but they can dissipate the social benefit from an innovation.").

112 This has been a pattern in Japan: Once a patent application disclosing a basic invention is published (as required by Japanese patent law), Japanese competitors immediately develop improvement inventions and file numerous patent applications, circumscribing the basic invention with every conceivable improvement. *See* UNITED STATES GENERAL ACCOUNTING OFFICE, U.S. COMPANIES' PATENT EXPERIENCE IN JAPAN 22-23 (1993) (surveying experience of 900 U.S. firms with the Japanese patent system). One of the major complaints of U.S. companies against Japanese patent practices is the narrow scope of protection afforded to pioneering inventions. *Id.* at 29-31; *see also Patent Protection in Japan*, EAST ASIAN EXEC. REP., Nov. 15, 1993, at 6.

113 The value of the race-to-invent theory as well as the other theories to predict case outcomes will be evaluated in Part IV.

3. Rent Dissipation Theory

The final economic theory to be outlined here is the "rent dissipation" theory as elaborated recently by Grady and Alexander.[114] According to them, rent dissipation theory posits that society benefits from receiving an innovation in excess of its development costs, and that the innovator should receive the difference between what society is willing to pay and the development cost.[115] The payment would be a rent (in the form of the patent monopoly) in order to prevent free-riders from copying the invention and thereby eliminating the incentive to invest in development.[116] They maintain that the defect in the patent system is that the incentives provided by the system may result in rent dissipation by redundant investment.[117] They identify three potential sources of rent dissipation that may tend to diminish the societal benefit from the patent system. The first is at the conception stage, where multiple competitors may invest in developing a basic invention, while only one can receive the patent prize.[118] The second is at the improvement stage, where the basic invention may "signal" various improvements and hence cause excessive competition to develop those improvements.[119] The third source of rent dissipation is where an excessive investment may be made in secrecy rather than relying upon the patent system for protection.[120] Thus, this theory would optimize societal benefit by minimizing rent dissipation from these three sources. Grady and Alexander conclude:

> Rent dissipation theory predicts that the courts will enforce a patent when the size of patent rent is proportionate to the rent dissipation that the *inventor's technological signal* would otherwise induce. In this situation, heating up the race to find new patentable inventions is a good social bargain, because patent enforcement cuts off races to improve. Otherwise, broad patent protection is unwise.[121]

Not only does the rent dissipation explain the entire patent system, but according to Grady and Alexander, it also "seems to explain actual patent rulings better than the rules and tests applied by the courts."[122] One startling aspect of this assertion is that Grady and Alexander would consider the worse patent case to be where a "valuable" invention was elegant and so could not be improved upon; hence, if enforced, it would "clearly induce

114 Grady & Alexander, *supra* note 7.
115 *Id.* at 308.
116 *Id.*
117 *Id.* at 308, 316.
118 *Id.* at 306-07. "In the perverse equilibrium that would result from a system awarding full control to the inventor who is first, the costs of developing dreams that ultimately fail would equal or exceed the benefit to society of those that succeed." *Id.* 307-08.
119 Grady & Alexander, *supra* note 7, at 308 ("The granting of a patent is justified . . . [when an invention signals improvements] because it eliminates the incentive to engage in wasteful improvement efforts."). The ability to identify when an improvement is "signaled" would seem critical to the predictive capability of rent dissipation theory. *See infra* text accompanying notes 345-61 (critiquing the inherent ambiguity of the term).
120 *Id.* at 308-09, 318.
121 *Id.* at 321 (emphasis added).
122 *Id.* at 322. "[T]he desire to limit rent dissipation explains how actual patent cases are decided, both before and after an invention comes into existence." *Id.* at 308.

more rent dissipation than it would avoid."[123] This would appear to contradict the reward, patent-induced, and prospect theories, and to a degree, the race-to-invent theory. Applying rent dissipation theory would result in the ultimate disincentive for investing in the creation of elegant (basic/revolutionary/pioneer) inventions generally considered the most valuable to society. Indeed, the rent dissipation theory would predict that: "Most likely to receive patent protection are inventions that, although of comparatively small value, nonetheless signal a large potential for improvement."[124]

A primary criticism of the rent dissipation theory is its difficulty of application to actual patent cases. How is it to be objectively determined that rent dissipation is minimized by a particular decision compared to another? As well put by Martin, in his comment on the Grady and Alexander article: "More fundamentally, how can we know when an invention signals the possibilities of improvements and when it [does] not."[125] Moreover, it is far from clear that all rent dissipation is bad. The competition that produces the highly beneficial invention may justify an equally large rent. Even without a patent system, there always will be some rent dissipation, for the market induces competitive investments.[126]

Another criticism leveled by Merges, in his response to the Grady and Alexander article, is that a number of decisions would have been decided otherwise except for doctrine applied under the facts of the case and that some of the cases would be decided differently today under evolved patent doctrine.[127] One also would be suspicious of a counter-intuitive theory that predicts the invalidity of a patent on an elegant invention (categorized as being unimprovable) and that predicts validity of a patent on an inelegant (detail) invention because it somehow signals improvements. The suspicion is heightened when the assertion is made: "Just as philosophers have applied 'Occam's Razor' to their analytical problems, so have patent courts applied its reverse."[128]

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123 *Id.* at 321.

124 *Id.* at 320.

125 Donald L. Martin, *Reducing Anticipated Rewards from Innovation Through Patents: Or Less is More*, 78 VA. L. REV. 351, 356 (1992).

126 Moreover, with respect to process inventions, as pointed out by Merges, secrecy seems to be the protection of choice, and trade secret may be more desirable than patents, because of the expense of enforcement and the difficulty of detecting infringement of process inventions. *See* Robert P. Merges, *Rent Control in the Patent Districts: Observations on the Grady-Alexander Thesis*, 78 VA. L. REV. 359, 376-77 (1992) [hereinafter Merges, *Rent Control*].

127 *Id.* at 366-69.

128 Grady & Alexander, *supra* note 7, at 325. Occam's Razor is defined as: "[A] scientific and philosophic rule that entities should not be multiplied unnecessarily which is interpreted as requiring that the simplest of competing theories be preferred to the more complex or that explanations of unknown phenomena be sought first in terms of known quantities." WEBSTER'S NINTH NEW COLLEGIATE DICTIONARY 816 (1989). The rule is named after William of Ockham (Occam) and also called "Law of Economy" or "Law of Parsimony," 8 NEW ENCYCLOPEDIA BRITANNICA 867 (15th ed. 1994). Grady and Alexander would reverse this in patent law to the effect that "entities are to be multiplied beyond necessity" presumably to the effect that patents claiming complicated (perhaps overly) inventions are more likely to be sustained than those claiming simple ("elegant") ones. Nonetheless, as this Article attempts to demonstrate, once there is "elegance" beyond a natural law, patent law seems to prefer the elegant as much as the good Franciscan did in the fourteenth century and science and philosophy do today.

C. Generalizations and Comparisons

The chart below attempts to illustrate, in a generalized way, the characteristic outcomes that would be predicted in actual litigation, respectively, by the five theories outlined above. Only the rent dissipation theory expressly claims and explicates predictive capability. The characteristic outcome attributed to the other theories in this article have been deduced, inferred, or extrapolated (with considerable trepidation) from the works of the various theorists. The five theories are identified on the left margin and the three characteristics—protectability (statutory subject matter and utility), conditions for protection (novelty/nonobvious), and the scope of protection (infringement)—along the right margin for each of the theories. Along the top margin, three types of inventions are identified—revolutionary (basic/pioneering/elegant), high benefit/cost ratio (market-induced/improvement), and low benefit/cost ratio (detail).

Theory	Revolutionary	High Benefit/ Cost	Low Benefit/ Cost	
Reward	Broad	—	—	Protectability
	High	High	High	Standard
	Broad	Medium	Narrow	Scope
Patent-Induced	Broad	—	—	Protectability
	High	High	High	Standard
	Broad	Narrow	Narrow	Scope
Prospect	Broad	—	—	Protectability
	Low	Low	Low	Standard
	Broad	Broad	Broad	Scope
Race-to-Invent	Narrow	—	—	Protectability
	High	High	High	Standard
	Narrow	Narrow	Narrow	Scope
Rent Dissipation	Narrow	—	—	Protectability
	"Signal Strength"	"Signal Strength"	"Signal Strength"	Standard
	"Signaled"	"Signaled"	"Signaled"	Scope

1. Protectability

The issue of protectability (statutory subject matter and utility) essentially only arises with respect to revolutionary inventions, and, as indicated on the chart, a broad interpretation of protectability would be posited by the reward, patent-induced, and prospect theories, while a narrow interpretation would be predicted by the race-to-invent and rent dissipation theories. A broad interpretation of statutory subject matter and utility is predicted by reward and patent-induced theories, because these theories seek to reward and induce revolutionary inventions at the cutting edge of knowledge. The prospect theory, on the other hand, while predicting a broad interpretation, does so on the theory that protecting technological information at an early stage provides the advantages of property. The race-to-invent theory would appear to predict a narrow interpretation of statutory subject matter and utility so as not to restrict access to technological information at an early stage of conceptualization. On the other hand, the rent dissipation theory predicts a narrow interpretation for protectability (particularly with respect to elegant inventions), because it is posited that such inventions do not signal any improvements and, therefore, should not be protected, for otherwise rent dissipation will result.[129]

Thus, in general, with respect to the protectability issue for revolutionary inventions, the reward, patent-induced, and prospect theories would tend to predict validity, while the race-to-invent and rent dissipation theories would tend to predict invalidity.

2. Conditions for Protection

The reward, patent-induced, and race-to-invent theories would all predict a high standard for protection. Thus, one would expect that a synergism requirement may be imposed and that secondary considerations, such as commercial success, would not be given high probative value as indicia of nonobviousness. A high standard would have little effect with respect to revolutionary inventions, because presumably these are at the cutting edge of technology. However, a high standard would tend to bar the patentability of certain high benefit/cost inventions and many low benefit/cost inventions. This is consistent with the reward theory, in that such inventions should not be rewarded beyond their contribution to society to avoid the high costs associated with routine inventions. This is also consistent with the patent-induced theory in the sense that this theory seeks to eliminate nonpatent-induced (high benefit/cost inventions), which would presumably be provided by market incentives rather than by the patent system, and low benefit/cost (detail) inventions, which may tend to be patent induced, but which are costly compared to the benefit provided.

In contrast, the race-to-invent theory presumably would impose a high standard for protection so as to eliminate patents that may impede access to improvements, thus permitting more inventions to reach the market-

129 Grady & Alexander, *supra* note 7, at 309 ("When an invention is so basic that it could never be improved, our theory does not predict patent protection because a patent would only increase total rent dissipation.").

place more quickly. The prospect theory, on the other hand, would seemingly impose a low standard for protection ("substantial novelty"), because of the assumption that most patented inventions face significant competition and, therefore, would not result in underutilization. Under the rent dissipation theory, the standard for patentability, in particular, nonobviousness, as well as secondary considerations such as indicia of nonobviousness, appear irrelevant, and the standard becomes the signal strength included within the patent disclosure in terms of the invention's potential for improvement.[130] With respect to revolutionary (elegant) inventions, the signal strength by definition is negligible as the invention is unimprovable. The categorization of inventions as high-benefit/cost and low-benefit/cost does not fit nicely into the rent dissipation theory. Presumably, patents on high-benefit/cost inventions would be ones that would signal a potential for improvement. These inventions are quite valuable to their owners as they find a ready market, and competitors would be likely to seek improvements unless barred by patents. On the other hand, patents on low-benefit/cost inventions are of limited value to their owners, because they only protect details in a competitive market, and moreover, presumably signal little potential for improvement as most of the improvements have already been made. Yet, rent dissipation theory posits that the inventions most likely to receive patent protection are those that are of "comparatively small value" but "nonetheless signal a large potential for improvement."

3. Scope of Protection

For revolutionary inventions, the reward, patent-induced, and prospect theories would all predict a broad scope of protection, so that literal and nonliteral infringement (under the doctrine of equivalents and contributory and induced infringement) would be broadly interpreted. The rationale behind broad protection under the reward and patent-induced theories is that revolutionary inventions are the important class of inventions to be protected and warrant broad protection as a reward and an inducement. The prospect theory, on the other hand, would provide broad protection so that the patent owner could achieve a broad coordinating function for improvements. In contrast, the race-to-invent and rent dissipation theories would provide a narrow scope of protection, although for different reasons. The race-to-invent theory would provide narrow protection so that competition for improvement inventions would be permissible to speed up the commercialization of this technology. The rent dissipation theory predicts at best a narrow scope of protection because such inventions, particularly the elegant ones, tend to be unimprovable; therefore, only those improvements that are signaled fall within the scope of protection.

The reward theory presumably would provide a medium scope of protection for high benefit/cost and a narrow scope for low benefit/cost inventions, respectively, based upon the rationale that the reward should be proportional to the contribution. The patent-induced theory, however,

130 *Id.* at 321.

would provide a narrow scope of protection for both high benefit/cost and low benefit/cost invention in order to minimize the costs of protecting such inventions. The prospect theory would seemingly provide broad protection for all types of inventions to permit coordination by the owner. Conversely, the race-to-invent theory, which is the antithesis of the prospect theory, predicts a narrow scope of protection for all types of inventions to afford competitors access for improving them. Accordingly, rent dissipation would seem to suggest a narrow scope of protection for low benefit/cost (detail) inventions, because most of the improvements have presumably already been signaled. With respect to high benefit/cost (improvement) inventors, if they signal further improvements, a broad scope of protection would be predicted.

The scope of protection afforded under the rent dissipation theory would depend upon the degree to which the patent disclosure signaled the alleged infringing subject matter. The greater the improvement signaled, the greater the scope of the patent. Revolutionary (elegant) inventions, if sustainable at all, would have a quite narrow scope of protection, being essentially unimprovable. With respect to high-benefit/cost and low-benefit/cost inventions, the rent dissipation theory's predictive value depends on the ability to identify accused subject matter as being signaled by the patent disclosure.[131]

4. Summary of Predictions

In sum, the reward, patent-induced, and prospect theories would tend to predict the validity and infringement of revolutionary inventions. The race-to-invent theories would tend to predict the validity but not the noninfringement of such patents, while the rent dissipation theory would tend to predict both invalidity and noninfringement. The prospect theory, indeed, tends to predict the validity and infringement of all patents. The patent-induced and race-to-invent theories would tend to predict the invalidity and noninfringement of both high benefit/cost and low benefit/cost inventions, as would the reward theory with respect to low-benefit/cost inventions. With respect to high-benefit/cost inventions, the rent dissipation theory would tend to predict more cases of validity and infringement than would the reward theory, presuming there is a signal. Aside from the prospect theory, only the rent dissipation theory would tend to predict validity and infringement of low benefit/cost inventions, according to the degree to which such inventions can signal improvement.

IV. Application of Theories

In this Part, the predictive powers of the various theories will be applied to actual cases. The primary reference will be the rent dissipation theory, which is the only one asserted to be predictive of actual case outcome. This theory will be compared primarily to the reward and the pat-

131 Grady and Alexander essentially equate the issues of patentability and infringement as hinging on the "signal." *Id.* at 347-48; *see infra* text accompanying notes 346-62 (discussing importance of "signals" to rent dissipation theory).

ent-induced theories and, more generally, to the prospect and race-to-invent theories. Special attention will be directed to cases involving inventions that are identified as being elegant. When appropriate, the historical background of certain inventions and their subsequent evolution will also be examined. Also, cases will be identified that are better explained by doctrine than by any economic theory and, in particular, the rent dissipation theory. The cases selected for discussion will generally be those indicated by Grady and Alexander as being best explained by their theory and supplemented by cases, otherwise identified, that cause considerable difficulty to the rent dissipation theory.

A. Protectability

1. Statutory Subject Matter

The 35 U.S.C. § 101 issue is whether a particular invention falls within one of the statutory classes of patentable inventions, namely, "process, machine, manufacture, composition of matter." Compliance with § 101 is a precondition for patentability. If an invention, as claimed, does not fall within one of these classes, the qualitative issues for patentability, novelty, nonobviousness, and utility need not be addressed. Grady and Alexander argue that rent dissipation theory explains statutory subject matter cases better than doctrine or the other economic theories. This assertion is challenged in this Article.

Starting with the "process" class, Grady and Alexander first select four cases to demonstrate the superiority of rent dissipation theory. These are: *O'Reilly v. Morse*,[132] *The Telephone Cases*,[133] *Tilghman v. Proctor*,[134] and *Morton v. New York Eye Infirmary*.[135]

In *Morse*, the Supreme Court held invalid claim eight, which claimed without reference to "specific machinery . . . the use of the motive power of . . . electro-magnetism, however developed for marking or printing intelligible characters, signs, or letters, at any distances . . . . "[136] The Court's rationale for invalidating this claim was that Morse was claiming exclusive rights over subject matter "which he has not described and indeed had not invented."[137] This rationale is directly in line with reward theory. One should not be rewarded for what one has not invented. Indeed, Morse had not discovered electromagnetism as the natural principle. Grady and Alex-

132 56 U.S. (15 How.) 62 (1854).
133 126 U.S. 1 (1888).
134 102 U.S. 707 (1881).
135 17 F. Cas. 879 (S.D.N.Y. 1862) (No. 9,865).
136 *Morse*, 56 U.S. (15 How.) at 112. The complete claim reads:

> I do not propose to limit myself to the specific machinery or parts of machinery described in the foregoing specification and claims; the essence of my invention being the use of the motive power of the electric or galvanic current, which I call electro-magnetism, however developed for marking or printing intelligible characters, signs, or letters, at any distances, being a new application of that power of which I claim to be the first inventor or discoverer.

Id.
137 *Id.* at 113.

ander consider the doctrine to stand for the proposition that a "'principle of nature' is not a patentable subject matter."[138]

Morse's claim was too broad in another sense. The only distinction over the prior art and the claim language is the use of "the motive power of . . . electro-magnetism . . . at any distances."[139] The prior art permitted communication at short distances within the power of batteries available at the time. The novelty of Morse's invention was the use of separate "relay" circuits and separate batteries that greatly extended the distance over which telegraphic communications would be transmitted.[140] Nonetheless, this was not "at any distances;" it took a good many years of development to extend the distances.[141]

The invalidation of claim eight is said to be consistent with rent dissipation theory because a claim of this scope would have covered "electronic communications of all types" and the signal from Morse's invention lacked the potential to set off a race to invent "analog and digital data transmissions, telephonic and satellite communications . . . fax machines, LEXIS terminals and space probe messages," as well as "cellular telephone[s]," no less.[142] This reduction to absurdity argument, which claims to cover every conceivable form of wired and wireless communications, does not comport with the doctrinal application of claim eight. The claim is limited to "the use of the motive-power of . . . electro-magnetism . . . for marking or printing intelligible characters . . . ."[143] If this claim were in effect today, it is improbable that a court would interpret such use of the *motive-power* of electromagnetism as encompassing the wireless transmission of, for example, digital signals, modulated at high frequency and not used as a driving force for the actual communication.[144]

138 Grady & Alexander, *supra* note 7, at 323; *see also* Merges & Nelson, *supra* note 13, at 850, who assert that the claim covers "all methods of communicating at a distance using electromagnetic waves." Whether "the motive power of the electric or galvanic current" can be read upon "electromagnic waves," e.g., generated at radio frequencies, is questionable. *Morse*, 56 U.S. (15 How.) at 112.

139 *Morse*, 56 U.S. (15 How.) at 112.

140 *See id.* at 72. The patent to Morse was issued in 1840 and reissued in 1848. Successful transmission of telegraphic signals between Baltimore and Washington D.C. was made in 1844—a distance of 40 miles. *See* E. A. MARLAND, EARLY ELECTRICAL COMMUNICATION 136-37 (1964). Marland questions whether Morse was the inventor of the "Morse" code. *Id.* at 134. The author suggested that Morse obtained the idea for successive circuits from another man. *Id.* at 136.

141 See, e.g., MARLAND, *supra* note 140, at 153-81, for a history of underwater telegraph cables.

142 Grady & Alexander, *supra* note 7, at 323. Moreover, as postulated by Grady and Alexander, it is the patent that must "signal" improvements. *Id.* at 319. Assume that Morse's patent specification stated that his invention could be used for voice communications but there was no claim eight. Would the telephone be "signaled" by this disclosure? Would this "signal" bar Bell from obtaining a patent on the telephone? Would the telephone infringe the Morse patent (without claim eight), presuming it was still in effect? The telephone "signal" in the Morse patent presumably would cause rent dissipation by others trying to "improve" Morse's invention unless the patent were deemed to cover the telephone. It is also interesting to note that fax machines are contemporaries of the telegraph and antedate the telephone. Patents date back to 1843. There was a dedicated line between Paris and Lyon for fax communications from 1865-1870. *See* IRA FLATOW, THEY ALL LAUGHED 62 (1992); *see also infra* notes 345-62 and accompanying text (discussing the importance of "signals" to rent dissipation theory).

143 *See supra* note 136 (quoting complete claim).

144 If claim eight had not been anticipated by prior art, the court could have limited the claim to what had been disclosed in the patent under the "reverse doctrine of equivalents." *See infra* text accompanying notes 318-28; *see also* Merges & Nelson, *supra* note 13, at 850-51 (finding the claim invalid because of a failure to satisfy an "enabling" requirement).

The patent-induced theory also explains the invalidation of claim eight. The fact that Morse may have been induced by the availability of a patent to initiate and continue to work on the telegraph does not override the reward aspect of the patent-induced theory; inventors should not be rewarded beyond what they, in fact, invent, however induced to invent.

The invalidation of claim eight is also consistent with the race-to-invent theory, but perhaps inconsistent with sustaining the other claims, which provided quite broad protection to Morse over the development of the telegraph. Only the prospect theory would not predict the invalidation of claim eight, as this would have provided Morse with broader coordinating control over the development of all communication systems.

Rent dissipation is maintained to explain the outcome of *The Telephone Cases*[145] on the basis that Alexander Graham Bell's claims are within the technology signaled by his inventions. Thus *Morse* is distinguished: Morse's claims did not signal, but Bell's did.[146] Doctrine and historical background surrounding the invention of the telephone would seem to explain far better the result in *The Telephone Cases.* Rent dissipation theory would appear to be correct that the invention of the telegraph did not signal the invention of the telephone. Indeed, it may well have retarded the invention of the telephone. Just prior to the invention of the telephone, both Elisha Gray and Alexander Graham Bell were working on improving telegraphic communication by means of multiplexing.[147] In the course of his investigations, Gray made a major breakthrough when he showed that different musical notes could be sent over wire and be reproduced at the other end, demonstrating the feasibility of transmitting voice over wires.[148] However, conventional wisdom at the time indicated that the important technology was the telegraph, and Gray devoted his attention to improving telegraphy.[149]

Bell, on the other hand, took the contrary view and dropped work on multiplexing for telegraph and pursued voice transmission.[150] Gray had conceived the telephone before Bell and had, indeed, made a sketch, which was practically identical to the one made several weeks later by Bell.[151] Bell, however, filed his patent application a few hours before Gray filed a caveat.[152] Gray, on the advice of patent counsel and his financial

145 126 U.S. 1 (1888).

146 Grady & Alexander, *supra* note 7, at 324. The claim by Bell was: "[T]he method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth." *The Telephone Cases,* 126 U.S. at 13-14. Unless this claim is limited to wired transmissions by the word "telegraphically," would this claim read on radio transmissions with audio modulation of the radio frequency waves being "similar in form to the vibrations of the air accompanying the said vocal or other sounds"?

147 *See* THOMAS PARKE HUGHES, AMERICAN GENESIS 55-56 (1989).

148 *See* FLATOW, *supra* note 142, at 76.

149 HUGHES, *supra* note 147, at 56.

150 *Id.* His financial bankers were not pleased as they wanted him to work on the telegraph. *See* ALVIN F. HARLOW, OLD WIRES AND NEW WAVES 353 (1936).

151 *See* FLATOW, *supra* note 142, at 82.

152 *See* HARLOW, *supra* note 150, at 357 (discussing the Patent Office procedure at the time, where Bell's application was the fifth entry for the day and Gray's caveat the thirty-ninth). No hour was indicated for the entries. Unlike the procedure of the time, a caveat was a document

backers, declined to contest Bell's priority on the grounds that the telephone had no commercial future.[153]

Shortly thereafter, Western Union became interested in the telephone and acquired Gray's rights.[154] Western Union also retained Thomas Edison to develop improvements in the telephone. He invented a transmitter superior to Bell's, which was patented.[155] After extensive litigation, the controversy between Bell and Western Union was settled. Western Union gave up its patent rights in telephones, including the Edison transmitter patent, in exchange for 20% of telephone rental income for the life of the patents.[156]

Grady and Alexander attempt to conform the sustaining of the Bell patent to the rent dissipation theory: "Bell's invention, for instance, no doubt signaled to other inventors the possibility of valuable refinements such as an improved voice box. Such improvements, if not covered by Bell's claims, would have an economic value approximating that of the original invention."[157] Evidently contrary to rent dissipation theory, Bell's claims did not cover Edison's "voice box" or Bell's patent did not signal the improvement. Indeed, it was a matter of survival for Bell Telephone to obtain a commercially viable transmitter to compete with Edison's trans-

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filed to establish the conception of an invention that had not yet been reduced to practice. Harlow comments:

> Had the clerk entered on his blotter the hour when each of these applications was filed, much litigation and bitter feeling might have been averted in the years that followed. As it was, it was believed by some for years afterwards that Gray was first with his application. It was charged under oath that being filed first, it lay near the bottom of the day's papers, and therefore, at the close of the day's business, was entered among the last on the records—Bell's entry being the fifth and Gray's the thirty-ninth. This theory was repudiated by the Patent Office officials, and the averment was gradually built up that Gray had arrived at the office two hours later than Bell's attorney. Thirty-four applications for patents and caveats must have made that an unusually busy two hours for the office. All charges, counter-charges and denials were made long after the event. Gray at first and for months afterward meekly accepted the theory that he had been beaten.
>
> What a crude system is ours for handling such matters! What a discredit to the boasted human ingenuity and justice! Why must invention be always a race in which the prize and the only prize is awarded to the swift, or a battle in which all the honors and emoluments are handed over to the strongest and most ruthless mauler? Haroun-al-Raschid would have thought of a better plan.

Id. In a near contemporaneous account, prior to Bell's first inventorship being established in the *Telephone Cases*, Count Du Moncel maintains that Gray's caveat was more than a mere conception but disclosed the telephone in significantly more detail than Bell's patent application and indeed disclosed a telephone that "would work perfectly." He concludes that: "Mr. Elisha Gray would certainly have obtained the patent, if the expiration of his *caveat* had not been the result of an omission of form in the Patent Office . . . ." COUNT DU MONCEL, THE TELEPHONE, THE MICROPHONE AND THE PHONOGRAPH 16 (1879, reprinted 1974); *cf.* HERBERT N. CASSON, THE HISTORY OF THE TELEPHONE 90-93 (1910) (Casson's critical account of Gray's claim of first inventorship).

153 *See* FLATOW, *supra* note 142, at 83.

154 *See* HARLOW, *supra* note 149, at 375.

155 Robert V. Bruce, *Alexander Graham Bell and the Conquest of Solitude, in* TECHNOLOGY IN AMERICA 105, 111 (Caroll W. Pursell, Jr. ed., 1981). Bell had offered his patent to Western Union for $100,000, which was refused. FLATOW, *supra* note 142, at 83.

156 Bruce, *supra* note 155, at 111. The Bell company also agreed to stay out of the telegraph business. *See* HARLOW, *supra* note 150, at 382-83.

157 Grady & Alexander, *supra* note 7, at 316.

mitter.[158] This was accomplished by the acquisition of the patent rights from Emil Berliner to a transmitter of equivalent quality.[159] Both Berliner's and Edison's transmitters were ultimately used by Bell Telephone.[160] The Bell and Edison patents were "blocking" patents. Western Union could not market telephones, and Bell needed a better transmitter for its telephone to be successful. Fortunately for Bell, the acquisition of the Berliner transmitter circumvented the block.[161]

The result in *The Telephone Cases* is nicely explained by both the reward and patent-induced theories. The telephone was clearly a patent-induced invention, and Bell should have been rewarded for his revolutionary invention. The magnitude of his reward was indeed tremendous, as the telephone patent is considered one of the most economically valuable in history.[162]

The result in *The Telephone Cases* is also consistent with the prospect theory, with Bell Telephone acting as the coordinator for the industry. However, some problems arise with respect to the race-to-invent theory. The settlement of the Bell patent litigation resulted in the Bell company controlling the telephone industry and Western Union controlling the telegraph industry—perhaps to the detriment of their rapid development.

In *Tilghman v. Proctor*,[163] the Supreme Court sustained the sole claim of Tilghman's patent, which involved "the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure."[164] The Court distinguished *Morse* on the basis that Morse's claim was "not for a process, but a mere principle," while Tilghman's claim was a process using the principle.[165] The Court refused to hold that Tilghman's invention lacked novelty because although fat acids "were accidentally and unwittingly produced" in previously used processes, the underlying principle of the invention was not recognized.[166]

Rent dissipation theory is said to explain this result, because if Tilghman had received a narrower patent, a race to patent improvements signaled by the original invention would have been set off.[167] Nonetheless, this is exactly what happened, even with the broad claim. Proctor and Gamble took a license under Tilghman's patent and then presumably improved it to make it commercially viable by adding lime, which permitted

158 Theodore Vail was brought in as manager of the Bell Company, according to Harlow, "with full knowledge of the fact that the Bell telephone must have a transmitter as good as Edison's or perish." HARLOW, *supra* note 150, at 379-80.

159 *Id.* at 377-81.

160 *Id.* at 385. There was disagreement over which transmitter was better, and telephones were supplied at the request of the Pennsylvania Railroad with both transmitters installed side-by-side. *Id.* at 386-87.

161 As pointed out by Merges, *Rent Control*, *supra* note 126, at 379-80 n.73: "In terms of the rent dissipation model, signalling appears to be measured only as of the filing date. Thus, perhaps Grady and Alexander would not permit blocking patents to issue."

162 *See* Bruce, *supra* note 155, at 111.

163 102 U.S. 707 (1881).

164 *Id.* at 709 (quoting Tilghman's patent, No. 11,766, Oct. 3, 1854).

165 *Id.* at 726-30.

166 *Id.* at 711-12. Merges would categorize this as a novelty case, establishing the principle that the unrecognized disclosure of the process does not qualify it as prior art. Merges, *Rent Control*, *supra* note 126, at 367.

167 Grady & Alexander, *supra* note 7, at 325.

the reduction in water temperature.[168] Proctor and Gamble thus dissipated rent in developing the invention to the commercial stage, for which it was forced to pay a rent. If the improvements made by Proctor and Gamble were obvious, it would then appear that sustaining the Tilghman claim was justified.[169] However, protection beyond signals that were obvious would appear to introduce cost into the patent system.

Grady and Alexander argue that the reward theory fails to explain *Tilghman*: "Why reward monopoly profits in an area beyond the imagination and labor of the inventor?"[170] But should not Tilghman be rewarded within the scope of obvious improvements—adding lime to reduce the water temperature? The patent-induced theory would explain the result. The patent system would be particularly important to Tilghman, an independent chemist, who would most likely have to rely upon others for the commercialization of his invention by licensing.

Race-to-invent theorists would be troubled by this case because of the retarding effect on improvements, particularly if Proctor and Gamble's improvement was nonobvious. The case, however, would be consistent with prospect theory, with Tilghman controlling the development of this particular art. Nonetheless, one might anticipate that Proctor and Gamble may have been better equipped to coordinate that development.

Grady and Alexander cited *Morton v. New York Eye Infirmary*[171] to illustrate the superiority of rent dissipation as a predictive theory of case outcome. They go so far to assert: "We think it virtually impossible to explain *Morton* under the reward theory of patent law."[172] The explanatory power of the reward theory would be more evident, of course, if the assumptions were not made that the case was rightly decided at the time and would be decided the same way today.

The explanatory power under the rent dissipation theory rests upon the categorization of the use of ether as an anesthetic agent as being elegant (i.e., unimprovable) and hence a patent was not required to stave off a race to improve.[173] As part of the factual background, Grady and Alexander state: "Although the intoxicating effects of ether were well-known at that time, its potential for anesthetic use was not known until the patentees, Jackson and Morton, did their path-breaking work."[174] It is generally

168 *Tilghman*, 102 U.S. at 733.

169 As stated by the Court:

> It is probably true, as contended for by the defendants, that by the use of a small portion of lime, the process can be performed with less heat than if none is used. It may be an improvement to use the lime for that purpose; but the process remains substantially the same. The patent cannot be evaded in that way.

Id.

170 Grady & Alexander, *supra* note 7, at 324.

171 17 F. Cas. 879 (S.D.N.Y. 1862) (No. 9,865).

172 Grady & Alexander, *supra* note 7, at 326.

173 *Id.* at 325-26.

174 *Id.* at 325-26. *Cf.* Attorney General Cushing's opinion:

> I think that, in the matter of which came this patent, a signal public service was performed, honorable to the parties and to their country. It was not the *discovery* of the anodyne effect of the inhalation of the ether or other anaesthetic agents. It was not the *invention* of the performance of surgical operations on the human body while reduced to temporary insensibility by anaesthesia. These were ideas familiar for ages to men of science, and the invention or discovery of which no more belongs to any individual as

agreed that Jackson did very little, if anything, with respect to this invention.[175] The question of whether or not Morton himself was the first inventor of using ether as an anesthetic agent in operations is subject to serious debate. A case can be made that Dr. Crawford W. Long had used ether in an operation as early as 1842, approximately six years prior to Morton.[176] As to the elegance of the use of ether as an anesthetic agent, chloroform appeared to be a strong competitor, particularly in the South during these early years.[177]

Most damaging to the rent dissipation theory in the *Morton* case would be a direct application of Occam's Razor.[178] Simply, the case was wrongly

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property, than electricity; the fusibility of metals; the specific medicinal effects of opium, cinchona, mercury; the capacity of sleep, which Cervantes speaks of as a valuable invention; or any other of the ascertained qualities of matter, functions of animal life, or laws of inanimate nature. Neither of those things constitutes the honorable service performed in the present instance. That service consisted in the suggestion and execution of a series of experiments, which resulted in demonstrating the safety and utility of employing, more frequently than had been done heretofore, known agents of anaesthesia, by known methods, in order to the known end of facilitating surgical operations. That was a great good, and worthy of due honor. Whether it involved anything patentable or not, from which to derive pecuniary profit, is a question of specific agents and of specific agency. If it does, that relation of the case belongs to the lower category of mechanical applications, not to the higher one of great scientific discoveries.

Morton's Anaesthetic Patent, 8 Op. Att'y Gen. 269, 278-79 (1856).

175 *See, e.g.*, BARBARA M. DUNCUM, THE DEVELOPMENT OF INHALATION ANAESTHESIA 103-04 (1947). Morton discussed the use of nitrous oxide and ether with Jackson, but withheld the fact that he had experimented with ether. Duncum comments on their relationship:

> Upon this last point Morton probably overestimated his powers of concealment and underestimated Jackson's perspicacity. In any case it was an irony of fate that Morton, with his fear of being forestalled and his subterfuges to prevent such a happening, should have turned to Jackson for information. For although Jackson was undoubtedly a distinguished scholar, particularly in the science of geology, he had a deplorable tendency, upon the most slender grounds, to try to father other people's inventions which gave promise of being outstandingly successful especially from a financial point of view. Within three months Jackson claimed that at this very interview *he* had suggested to Morton the use of ether vapour as an inhalant to obviate surgical pain.

Id.

176 *Id.* at 89-93. Dr. Long was a physician practicing in rural Jefferson, Georgia, who reported that he used ether as an anesthetic on March 30, 1842 to remove a tumor from a boy's neck. However, Long did not publicly disclose his successful use of ether in operations until 1852, six years after Morton's well publicized use of ether in 1846. For rather poignant and expectedly partial accounts of the work of Morton and Long, see WILLIAM J. MORTON, M.D., THE INVENTION OF ANAESTHETIC INHALATION; OR, DISCOVERY OF ANAESTHESIA. (1880) (by Dr. Morton's son) and FRANCES LONG TAYLOR, CRAWFORD W. LONG AND THE DISCOVERY OF ETHER ANESTHESIA (1928) (by Dr. Long's daughter).

177 *See* DUNCUM, *supra* note 175, at 11-15. There also appears to have been significant rent dissipation in perfecting a mechanism for administration of ether. When the physicians at Massachusetts General found out that Morton was applying for a patent to protect his inhalation device, they discontinued its use and poured ether directly onto a bell-shaped sponge, which was applied both over the mouth and nose of the patient. *Id.* at 11. Moreover, during the period 1846-1847, immediately following the public disclosure of the use of ether for anesthesia, a large number of inhalers were developed throughout the world. *Id.* at 130-63.

178 The same criticism can be leveled at other cases relied upon by Grady and Alexander. For example, they cite an obscure case, *In re* Haas, 81 F.2d 408 (C.C.P.A. 1936), as another example of an "elegant" invention, where the rent dissipation theory explains the result better than the doctrine actually applied by the court. *See* Grady & Alexander, *supra* note 7, at 327. Haas claimed: "A method of slicing and wrapping bread which consists in [sic] moving the bread through a zone of sterilized air, slicing the bread in said air, and finally wrapping said bread in said sterilized air." *Haas*, 81 F.2d at 409. The court held that this did not amount to "invention" in that the inventor had merely discovered the scientific fact that the blades were the contaminants in slicing bread, and it was obvious to sterilize the blades in view of prior art teaching

decided. The definition of "process" found in § 100(b) of the 1952 Patent Act reverses *Morton*: "The term 'process' means process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material." Under this definition, the Morton invention would qualify as statutory subject matter as a "new use" for a known "composition of matter, or material," i.e., ether. This type of method invention was approved by the Patent Office and courts even prior to the 1952 codification.[179]

In *Dawson Chemical Co. v. Rohm & Haas Co.*,[180] the Supreme Court recognized the patentability of a process that involved the use of a known composition of matter (propanil) for controlling weeds in rice fields. In view of the statutory definition of new use inventions and the *Dawson Chemical* case, it would seem "virtually impossible" to maintain that *Morton* is still good law.[181] Obviously, while not as great a benefit to society as the use of ether as an anesthetic agent, the use of propanil as a herbicide was even more elegant, as propanil had no other known use but as a herbicide.[182]

Section 100(b) and *Dawson Chemical* are fully consistent with the reward theory. Had *Morton* been correctly decided, *Morton* would have been appropriately rewarded for whatever contribution he made. According to the patent-induced theory, the result in *Morton* can be justified, for it was likely that the use of ether for anesthesia would have been discovered soon irrespective of the patent system; thus, awarding the patent was unnecessary. The prospect theory would not predict the actual outcome in *Morton*. Of course, if the invention were truly unimprovable, there would be little to coordinate aside from collecting royalties. The race-to-invent theory would

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similar sterilizations. *Id.* at 410. Grady and Alexander disagree with the court's conclusion that the invention was obvious. *See* Grady & Alexander, *supra* note 7, at 327. Nonetheless, it is another matter to categorize the invention as "elegant" and therefore unimprovable and hence unprotectable. The simple solution would be to conclude that the case was wrongly decided on the "invention" issue. In hindsight, the inventor would have been well advised to keep the process secret rather than to have applied for a patent.

Wyeth v. Stone, 30 F. Cas. 723 (C.C.D. Mass. 1840) (No. 18,107), and Cochrane v. Deener, 94 U.S. 780 (1877), are cited for examples of process cases that are better explained by rent dissipation theory than by the mere function-of-the-machine doctrine. *See* Grady & Alexander, *supra* note 7, at 328. As this doctrine is no longer applied (*see In re* Tarczy-Hornoch, 397 F.2d 856 (C.C.P.A. 1968)), this itself would eliminate any perceived inconsistency with the result in *Wyeth*, where the claims were held invalid, compared to *Cochrane*, where the claims were sustained. The reward theory nicely explains both cases. Wyeth had not invented all methods of cutting ice into a uniform shape and therefore deserved no reward for uninvented ones, while Cochrane did deserve a reward for his contribution to the art of a specific method of separating flour from meal.

179 *See, e.g.*, Tolfree v. Wetzler, 25 F.2d 553 (3d Cir.), *cert. denied*, 278 U.S. 628 (1928); *Ex parte* Muller, 81 U.S.P.Q. (BNA) 261 (Pat. Off. Bd. App. 1947); *see also* 1 DONALD L. CHISUM, PATENTS § 1.03[8][c] (1995) (discussing cases involving new use inventions).

180 448 U.S. 176 (1980); *see also* Hodosh v. Block Drug Co., 833 F.2d 1575 (Fed. Cir. 1987), *cert. denied*, 485 U.S. 1007 (1988) (involving new use for potassium nitrate).

181 *See* PAUL GOLDSTEIN, COPYRIGHT, PATENT, TRADEMARK AND RELATED STATE DOCTRINES 444 (3d ed. 1993):

> The new definition [35 U.S.C. § 101(b)] also dispelled the lingering question left by a much earlier decision, *Morton v. New York Eye Infirmary*... which held that plaintiffs, who had discovered the anesthetic qualities of the old compound, ether, were not entitled to a patent on the process of using ether as an anesthetic in surgery.

Id.

182 *Dawson Chem.*, 448 U.S. at 182.

seem to support the result in *Morton*, particularly in view of the rapid commercialization of the method and also the considerable competition to improve the inhalation device used to apply the ether.[183]

Grady and Alexander appear to have it backwards with respect to § 101 cases decided by the Supreme Court relating to computer programs. They categorize the invention in *Gottschalk v. Benson*[184] for converting pure binary into binary decimal numbers as being elegant and, accordingly, unimprovable.[185] Hence, rent dissipation theory explains the result that the claimed invention (categorized as an algorithm) was not within the statutory classes of invention. In contrast, they conclude that the invention of a computer-program-controlled rubber curing process as claimed in *Diamond v. Diehr*[186] was considerably less elegant than that in *Benson* and thus signaled various improvements.[187]

In the first place, it is not apparent that the *Benson* invention was all that elegant. The claims are for a specific type of conversion, using particular logic elements.[188] Moreover, whatever elegance may have existed was

183 *See supra* note 177.
184 409 U.S. 63 (1972).
185 Grady & Alexander, *supra* note 7, at 329.
186 450 U.S. 175 (1981).
187 Grady & Alexander, *supra* note 7, at 324-30.
188 For example, claim eight of the Benson application reads:

> The method of converting signals from binary coded decimal form into binary which comprises the steps of
> (1) storing the binary coded decimal signals in a re-entrant shift register,
> (2) shifting the signals to the right by at least three places, until there is a binary '1' to the second position of said register,
> (3) masking out said binary '1' in said second position of said register,
> (4) adding a binary '1' to the first position of said register,
> (5) shifting the signals to the left by two positions,
> (6) adding a '1' to said first position, and
> (7) shifting the signals to the right by at least three positions in preparation for a succeeding binary '1' in the second position of said register.

Benson, 409 U.S. at 73-74 (Appendix). The conclusion by Grady and Alexander that the algorithm claimed in Parker v. Flook, 437 U.S. 584 (1978), relating to alarm updating, would be categorized as "elegant" and would be infringed by the calculation of GPA's and batting averages is seriously questioned. Grady & Alexander, *supra* note 7, at 329 n. 94. Claim one of the Flook application reads:

> A method for updating the value of at least one alarm limit on at least one process variable involved in a process comprising the catalytic chemical conversion of hydrocarbons wherein said alarm limit has a current value of
>
> $$Bo+K$$
>
> wherein Bo is the current alarm base and K is a predetermined alarm offset which comprises:
> (1) Determining the present value of said process variable, said present value being defined as PVL;
> (2) Determining a new alarm base B_1; using the following equation:
> $$B_1 = Bo(1.0\text{-}F)+PVL(F)$$
> where F is a predetermined number greater than zero and less than 1.0;
> (3) Determining an updated alarm limit which is defined as B_1+K; and thereafter
> (4) Adjusting said alarm limit to said updated alarm limit value.

Parker, 437 U.S. at 596-97 (Appendix). There certainly is no indication that the invention was for any general system of calculation, but was directed to a specific technology. *Cf.* Justice Douglas' comment in *Benson*, 409 U.S. at 68: "The end use [of the BC to BCD conversion] may . . . vary from the operation of a train to verification of drivers' licenses to researching the law books for precedents . . . ."

soon lost, as conversion from pure binary to binary coded decimal proved inefficient for calculations.[189] On the other hand, if any invention could be categorized as being elegant in the sense of being unimprovable, it would appear to be the *Diehr* invention. The only novel element in the process was the use of a computer program to solve a well known equation used for calculating the cure time in a molded rubber process. What could be improved? The process and the apparatus used were well known, and it would appear that any computer program capable of solving the equation would result in infringement. Hence, according to rent dissipation theory, no patent was needed since the invention was unimprovable.

It may be admitted that the reward theory does not explain the result in *Benson*. The elegant response is that the case was wrongly decided.[190] Various decisions of the Court of Appeals for the Federal Circuit have made serious inroads into *Benson*.[191]

Reward theory would seem to explain *Diehr* as providing a contribution to the rubber curing art. Patent-induced theory, however, would seem to explain *Benson*, because, in all likelihood, if this were such a simple, elegant invention it would have been invented irrespective of the patent system. The same, however, would seem to be true with respect to *Diehr*—all that was needed was a computer program to perfect the curing process.

The race-to-invent theory would be consistent with *Benson* but not *Diehr*. A broad patent on the conversion of binary to binary coded decimal would retard developments, as would a broad patent on the computer control of an old process. The prospect theory would fail to explain *Benson* but would explain *Diehr*, as permitting the coordination of the development of

189 As one author noted:

> BCD is not often used in modern high-speed digital computers for two good reasons. First, as was already pointed out, the BCD code for a given decimal number requires more bits than the straight binary code and is therefore less efficient. This is important in digital computers because the number of places in memory where these bits can be stored is limited. Second, the arithmetic processes for numbers represented in BCD code are more complicated than straight binary and thus require more complex circuitry. The more complex circuitry contributes to a decrease in the speed at which arithmetic operations take place. Calculators that use BCD are therefore considerably slower in their operation than computers.

RONALD J. TOCCI, DIGITAL SYSTEMS 27-28 (1985).

190 *See, e.g.*, Donald S. Chisum, *The Patentability of Algorithms*, 47 U. PITT. L. REV. 959 (1986) [hereinafter Chisum, *Algorithms*] (severely criticizing the *Benson* decision). *Cf.* Pamela Samuelson, *Benson Revisitied: The Case Against Patent Protection for Algorithms and Other Computer Program-Related Inventions*, 39 EMORY L.J. 1025 (1990). The present author tends to agree with Chisum. *See* Oddi, *Uneasier Case*, *supra* note 10, at 414-16.

191 *See, e.g.*, *In re* Alappat, 33 F.3d 1526 (Fed. Cir. 1994) (en banc) (holding that a programmed computer is a "machine" under § 101); Arrhythmia Research Technology, Inc. v. Corazonix Corp., 958 F.2d 1053 (Fed. Cir. 1992) (holding that a method of analyzing electrocardiograph signals is a statutory subject matter); *In re* Iwahashi, 888 F.2d 1370 (Fed. Cir. 1989) (reciting "read only memory" as sufficient to avoid § 101 rejection as an algorithm); *see also* cases collected in Samuelson, *supra* note 190, at 1113-22; Oddi, *Uneasier Case*, *supra* note 10, at 412-16, 427-29; Richard H. Stern, *Tales from the Algorithm War: Benson to Iwahashi, It's Deja Vu All Over Again*, 18 A.I.P.L.A. Q.J. 371, 376 ("*Iwahashi*, for all practical purposes, goes back to the CCPA's immediately pre-*Benson* standard."); *cf. In re* Trovato, 33 U.S.P.Q.2d (BNA) 1194 (Fed. Cir. 1994) (finding methods and approaches for solving "shortest path problem" in computer graph theory not statutory subject matter); *In re* Warmerdam, 33 F.3d 1354 (Fed. Cir. 1994) (method of creating data structure for controlling motion of object not statutory subject matter, but apparatus is); *In re* Schrader, 22 F.3d 290 (Fed. Cir. 1994) (method of doing business nonstatutory as preempting mathematical algorithm).

this art; however, as explained previously, there appears to be little to be improved.

The *pencil/eraser* cases (*Reckendorfer v. Faber*[192] *and Rubber Tip Pencil Co. v. Howard*)[193] are said to be analogous to *Morton* and to be best explained by rent dissipation theory.[194] The invention claimed in these patents was a combination including a pencil that incorporated an eraser at one end. The patent was held invalid in both cases on the basis that they did not rise to the requisite level of "invention." Rent dissipation theory is said to provide a better explanation because, like Morton's ether anesthesia, the pencil/eraser was "too valuable relative to the amount of improvement-stage rent dissipation that patent enforcement would alleviate."[195]

The *pencil/eraser* cases, of course, are not statutory subject matter cases; thus the reward theory would explain them on the basis that no reward should be provided for lack of invention in terms of novelty or nonobviousness. The *pencil/eraser* cases are perhaps even better explained by the patent-induced theory. These inventions would find a huge market and would have been invented by market forces whether or not there was a patent system.[196] The cases would be analogous to *Morton* in the sense that highly marketable and low-cost inventions generally do not need the patent incentive to be created — the market itself is sufficient. On the other hand, the prospect theory would support the validity of these patents, provided the minimum standard of "substantial novelty" had been met. Conversely, the race-to-invent theory would predict the outcome in these cases, thus permitting competition to further develop the pencil art as rapidly as possible.[197]

Two cases relating to the statutory class of "manufactures" are said to be irreconcilable on doctrinal grounds but can be reconciled under rent dissipation theory.[198] In *American Fruit Growers v. Brogdex*,[199] the Supreme Court held that a chemically impregnated orange was not a "manufacture." In contrast, in *Steinfur Patent Corps. v. William Beyer, Inc.*,[200] a patent on a process of dyeing animal furs to lighter colors was sustained by the Second Circuit. Rent dissipation is said to rationalize these presumably conflicting decisions on the basis that the invention in *Brogdex* was elegant and hence unimprovable, while in *Steinfur*, the invention was more complicated and hence signaled numerous improvements.[201] The Occam's Razor way of rationalizing the cases is to conclude that the Supreme Court was wrong in concluding that an impregnated orange was not a "manufacture." Indeed,

192 92 U.S. 347 (1876).
193 87 U.S. (20 Wall.) 498 (1874).
194 Grady & Alexander, *supra* note 7, at 330-31.
195 *Id.* at 331.
196 Pencils with an eraser inserted at one end of the shaft became known as "penny pencils." These could still be purchased in the early 1940s for less than a penny. It is estimated that by the first decades of the twentieth century about 90% of all pencils came with erasers attached. *See* HENRY PETROSKI, THE PENCIL 177-78 (1990).
197 Perhaps such development would include mechanical pencils with affixed and even replaceable erasers. Were these improvements "signaled"?
198 Grady & Alexander, *supra* note 7, at 332-33.
199 283 U.S. 1 (1931).
200 62 F.2d 238 (2d Cir. 1932).
201 Grady & Alexander, *supra* note 7, at 333.

process claims in this patent were held invalid for lack of novelty; a prior art patent taught impregnation plus coating fruit with gelatin.[202] Impregnating fruit clearly anticipated the *Brogdex* invention, the gelatin step being irrelevant for doctrinal purposes.[203] The prior art teaching also would clearly anticipate the "manufacture," because it taught a product that had been impregnated. All theories support the nonpatentability of inventions that lack novelty.[204]

With respect to the final category of statutory subject matter in § 101, "composition of matter," Grady and Alexander insist that two Supreme Court cases relating to this issue are doctrinally irreconcilable. These are *Funk Bros. Seed Co. v. Kalo Inoculant Co.*[205] (invalidating claims to noninhibiting strains of bacteria) and *Diamond v. Chakrabarty*[206] (sustaining claims to a crude oil-eating microorganism). The rationale again under rent dissipation theory is to pigeonhole Bond's invention in *Funk* as being elegant (i.e., unimprovable), thus not requiring a patent to inhibit rent dissipation at the improvement stage.[207] Contrary to this, the *Chakrabarty* invention is categorized as inelegant, thus signaling improvements, which, in the absence of the patent, would cause rent dissipation.[208] The Supreme Court's rationale in *Funk* was to categorize the "qualities of these bacteria [rhizobia]" to be "manifestations of the laws of nature, free to all men and reserved exclusively to none," and hence a patent could not be granted for the discovery of the "hitherto unknown phenomenon of nature."[209] Surely this is inconsistent with the doctrine in *Chakrabarty*, in that both claim living matter created by humans, rather than being "discovered;" again, the elegant resolution is that *Funk* was wrongly decided, and if it arose today, a contrary result would be reached.

In terms of the elegance of the invention in *Funk*, it may be noted that crop rotation had solved the problem of nitrogen fixation for millennia.[210] Also, the use of crop-specific rhizobia worked quite well.[211] Moreover, Bond's invention was ill-timed. Nitrogen fertilizers came into widespread

202 "If it be assumed that the process claims under consideration cover an invention, we think this lacked novelty . . . . The underlying conception had been adequately revealed in Bishop's Patent of 1901." *Brogdex*, 283 U.S. at 13.

203 *Id.* at 14.

204 Grady and Alexander distinguish *Steinfur* on the basis that it was a "complicated process that might easily suggest improvements." Grady & Alexander, *supra* note 7, at 333. It might be just as easy to say that the complicated process had been improved to perfection. The Second Circuit distinguished *Brogdex* on the ground that the bleached furs had a new beneficial use compared to the same use for the impregnated orange. *Steinfur*, 62 F.2d at 240. Whether one agrees with this distinction or not, it does not appear to relate to the complexity of the dying process but to the resulting product—the dyed furs as the "manufacture."

205 333 U.S. 127 (1948). Professor Chisum would interpret *Funk* as "an interpretation of the nonobviousness or 'invention' requirement, and not of the statutory classes of subject matter." CHISUM, *supra* note 179, § 1.02[7], at 1-37.

206 447 U.S. 303 (1980).

207 Grady & Alexander, *supra* note 7, at 334.

208 *Id.* at 334-35.

209 *Funk*, 333 U.S. at 130.

210 *See* WILLIAM D.P. STEWART, NITROGEN FIXATION IN PLANTS 11 (1966) ("Their beneficial effect on the soil . . . was realized by the ancient Chinese, Greeks, and Romans, so that the widespread use of legumes in crop rotation was well established long before the reason why they were beneficial was discovered.").

211 *See id.* at 119.

use after Word War II.[212] Today the concern is whether the right rhizobia is present to optimize nitrogen fixation. A multi-strain inoculation may be used to inhibit naturally occurring competitive rhizobia.[213]

With respect to Chakrabarty's invention, even though asserted to have signaled improvements, it was never commercially exploited: The microorganism evidently did not have much of an appetite for crude oil.[214] Also, concerns about the introduction of genetically engineered microorganisms into the environment weighed against commercialization.[215] Attention has now turned to naturally occurring microbes for oil spill clean-ups and other bioremediation applications.[216]

A recurring problem in patent law is whether claims should be granted on only the process for making a product or on both the process and the product. This was the issue in *Chakrabarty*, where the Patent and Trademark Office (PTO) had allowed claims on the process of producing the microorganism and on the combination of the microorganism disposed on a carrier (e.g., straw). In addition, the applicant insisted on a patent on the microorganism itself.[217] Rent dissipation theory is said to explain allegedly inconsistent opinions by courts with respect to granting only process claims sometimes and both process and product claims at others.[218] *Merck & Co. v. Olin Mathieson Chemical Corp.*[219] is given as an example where product claims were upheld for a "vitamin B-12 active composition,"[220] which the court categorized as being previously "unidentified and unknown,"[221] even though vitamin B was "produced in minute quantities in the bodies of cattle."[222] According to rent dissipation theory, the product claims were justified because without such claims, a race for others to find other methods of synthesizing the composition would result.[223] On the other hand, where the product was already known, such as in *Cochrane v. Badische Anilin & Soda Fabrik*,[224] only process claims would be justified, because it would be unlikely that others would dissipate rent in searching for alternative methods of making the known substance.[225] Both of these cases are consistent with well established patent doctrine. Whatever the statutory class of invention, all claims must satisfy all the requirements for the invention. No the-

212 William E. Newton & Barbara K. Burgess, *Nitrogen Fixation: Its Scope and Importance, in* NITROGEN FIXATION 1, 2 (Achim Müller & William E. Newton eds., 1983).

213 R. J. Roughly, *The Production of High Quality Inoculants and their Contribution to Legume Yield, in* SYMBIOTIC NITROGEN FIXATION IN PLANTS 125, 126 (P. S. Nutman, ed., 1976) ("[I]t is desirable to use the best strain available for a particular legume in order to avoid developing problems of competition from less effective strains.").

214 *See* Barnaby J. Feder, *Toxic Waste: Bacteria to the Rescue*, N.Y. TIMES, June 27, 1990, at D1, D7 ("Mr. Chakrabarty's microbe performed too poorly to have any commercial value, so the question of releasing it never arose.").

215 *See* Dahlem, *Las Vegas Told of Toxic-Degrading Genes*, 10 BIOTECHNOLOGY NEWSWATCH 4 (1990).

216 *See* Mimi Bluestone et al., *Microbes to the Rescue*, CHEM. WK., Oct. 29, 1986, at 34.

217 Diamond v. Chakrabarty, 447 U.S. 303, 305-06 (1980).

218 Grady & Alexander, *supra* note 7, at 336-38.

219 253 F.2d 156 (4th Cir. 1958).

220 *Id.* at 157 (claim one).

221 *Id.* at 163.

222 *Id.* at 161.

223 Grady & Alexander, *supra* note 7, at 337.

224 111 U.S. 293 (1884).

225 Grady & Alexander, *supra* note 7, at 337.

ory would justify a grant of a patent on a product already in the public domain. Of course, only in those instances where there is a new, useful, and nonobvious product and a new, useful, and nonobvious process for making that product are both categories of claims authorized. Granting product claims for purifying a known composition of matter would seem to induce rent dissipation at the conception stage.

Dawson Chemical Co. v. Rohm & Haas Co.,[226] which involves only method claims for using propanil as an herbicide in rice fields, is another example of the explanatory failure of rent dissipation theory. Propanil was a known compound, and the patent on the compound had been held invalid on the ground of lack of novelty.[227] Propanil had no other known uses and the claimed process could not be improved; therefore, rent dissipation would predict that no patent should have been granted. Moreover, protection of the process was tantamount to protection of the product (propanil) because the product could be used in no other way. It may well be that sustaining such patents will set off a race to find uses for presently useless compounds.[228]

Finally, a class of cases largely ignored by Grady and Alexander involve pharmaceutical inventions, where the compound patented is elegant in the sense of being unimprovable.[229] The spotted history of patent protection on aspirin highlights the difficulty of rent dissipation as a predictive theory.[230] The invention of aspirin by Felx Hoffman in 1897 involved the synthesis of acetylsalicylic acid (ASA) in a pure form. The active ingredient (salicin) had been known to have therapeutic value since, at least, the time of Hippocrates.[231] Less pure versions, however, had severe side effects.[232] A crude form of ASA had been synthesized in 1853 by Gerhardt and a purer version in 1869 by Kraut.[233] It has been said: "Hoffman found ASA

226 448 U.S. 176 (1980).

227 *Id.* at 181-82. The patent on propanil was assigned to Monsanto and found invalid in Monsanto Co. v. Rohm & Haas Co., 312 F. Supp. 778 (E.D. Pa. 1970), *aff'd*, 456 F.2d 592 (3d Cir.), *cert. denied*, 407 U.S. 934 (1972). Rohm & Haas obtained the patent at issue in *Dawson Chem.* when it prevailed over Monsanto in an interference over who was the first inventor of the use of propanil as an herbicide. *Dawson Chem.*, 448 U.S. at 182 n.1.

228 This was considered a desirable end by the majority in *Dawson Chem. Dawson Chem.*, 448 U.S. at 221-22.

229 These pharmaceuticals tend not only to be unimprovable from a technological standpoint but also from the standpoint of the disincentive for improvement because of the highly expensive and lengthy approval process before the Food and Drug Administration.

230 *See* CHARLES C. MANN & MARK L. PLUMMER, THE ASPIRIN WARS: MONEY, MEDICINE AND 100 YEARS OF RAMPANT COMPETITION (1991) for a history of the development of the aspirin industry. They summarize the trademark status of the word "aspirin":

> In some nations, such as the United States, the United Kingdom, and France, aspirin is the common name for the chemical acetylsalicylic acid, and any company may use that name to describe its product. But ASPIRIN® is a registered trademark of Bayer AG, Germany, in approximately seventy countries worldwide. And in Canada, it is a registered trademark used exclusively to identify analgesics manufactured and distributed by Sterling-Winthrop, Inc.

Id. at 4. In Bayer Co. v. United Drug Co., 272 F. 505 (S.D.N.Y. 1921) (L. Hand, J.), the trademark "Aspirin" was held to be generic for the general public but still had trademark significance for manufacturing chemists, physicians and retail druggists.

231 MANN & PLUMMER, *supra* note 230, at 21.

232 *Id.* at 22, 25.

233 *Id.* at 25.

not so much in the laboratory as in the library."[234] Hoffman was denied a German patent on the product ASA, because, at the time, only processes were protected, and he was denied a patent on the process because it was held not to be new.[235]

In contrast, patents were granted on ASA in England and the United States. The patent was held invalid in England[236] but sustained in the United States in *Kuehmsted v. Farbenfabriken of Elberfeld Co.*[237] The U.S. patent covered the product ASA. Most interestingly, there was no Canadian patent, so the infringer was importing aspirin made in Canada into the United States.[238] A patent on the process alone in the U.S. would not have barred imports.[239] Indeed, no attempt was made to prove how the aspirin was made.[240] One would expect that sustaining product claims on aspirin would result in significant rent dissipation at the conception state with no amelioration at the improvement stage in the U.S. as compared to Germany, the UK and Canada.

Eli Lilly & Co. v. Premo Pharmaceutical Lab., Inc.[241] is an example of a pharmaceutical patent case that is virtually impossible to explain under rent dissipation theory. Lilly owned patents on cephalexin, which is an oral antibiotic commonly used as a substitute for penicillin. The court affirmed the grant of a preliminary injunction, concluding that there was a "high probability of success on the merits" that the patent would be sustained.[242] The district court had found: "[T]he drug yielded the unexpected property of being almost 100% absorbable in the bloodstream."[243] It is difficult to conceive how this could be improved.

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234 *Id.*

235 *Id* at 28.

236 *Id.* at 35. *See* Farbenfabriken vormals Friedvich Bayer & Co. v. Chemische Fabrik Von Heyden, 22 R.P.D. & T.M. 501 (1905) (holding that the patent on ASA was for a product rather than a process for purification and was invalid as being anticipated by the prior art; but even if a process, it was also anticipated).

237 179 F. 701 (7th Cir. 1910), *cert. denied*, 220 U.S. 622 (1911).

238 MANN & PLUMMER, *supra* note 231, at 35-36.

239 This loophole has been closed somewhat by the enactment of 35 U.S.C.A. § 271(g) (West Supp. 1995):

> Whoever without authority imports into the United States or offers to sell, sells or uses within the United States a product which is made by a process patented in the United States shall be liable as an infringer, if the importation, offer to sell, sale, or use of the product occurs during the term of such process patent. In an action for infringement of a process patent, no remedy may be granted for infringement on account of the noncommercial use or retail sale of a product unless there is no adequate remedy under this title for infringement on account of the importation or other use or sale of that product. A product which is made by a patented process will, for purposes of this title, not be considered to be so made after—
>
> (1) it is materially changed by subsequent processes; or
>
> (2) it becomes a trivial and nonessential component of another product.

Id.

240 *Kuehmsted*, 179 F. at 702 ("The appellant sells an article having an identical formula and responding to the characteristics set forth in the claim-that being the sole proof of infringement (appellant's process not being shown) . . . . ").

241 630 F.2d 120 (3d Cir.), *cert. denied*, 449 U.S. 1014 (1980).

242 *Id.* at 138.

243 *Id.* at 122.

Pharmaceutical companies rely heavily on the patent system.[244] Patent protection is needed to justify their huge investments in the development of new drugs. For example, Lilly spent approximately $10 million in research and development on cephalexin and another $1.8 million on its clinical testing on humans, required by the FDA for approval.[245] Thus, many pharmaceutical inventions would be classed as patent-induced inventions. Their being sustained is fully consistent with the reward and patent-induced theories, while the rent dissipation theory would predict their invalidity. One would thus expect high rent dissipation at the conception in the competition to develop the next elegant pharmaceutical. Reward and patent-induced theories justify this result because of the perceived benefits to society over the costs of protecting such inventions. The prospect theory would be explained on the ground of the need to have single coordination, and Kitch is even willing to admit that certain "exceptional" pharmaceutical patents grant monopoly powers.[246] On the other hand, race-to-invent theory would be troubled by broad protection as retarding whatever improvements can be made.

If the important class of high-cost elegant inventions typified by pharmaceutical inventions cannot be explained by the rent dissipation theory, then what is left? The only category would seem to be the low-cost elegant inventions, such as *Morton,* and the *pencil/eraser* cases. However, with re-

244 After reviewing various empirical studies over a thirty-year period of the value of patents to innovators, Von Hippel concludes:

> In sharp contrast to the situation pertaining in most other industries and the electronics field in particular, the patent grant often confers significant benefit to innovators in the pharmaceutical field. My discussions with patent attorneys working for pharmaceutical firms brought out two likely reasons for this situation. First, unusually strong patents are obtainable in the chemical field, of which pharmaceuticals is a part. Second, it is often difficult to invent around a pharmaceutical patent.
>
> Pharmaceutical patents can be unusually strong because one may patent an actual molecule found to have useful medical properties *and* its analogs. One need not make each analog claimed but can simply refer to lists of recognized functional equivalents for each component of the molecule at issue . . . .
>
> Many pharmaceutical patents are difficult to invent around today because the mechanisms by which pharmaceuticals achieve their medical effects are often not well understood.

ERIC VON HIPPEL, THE SOURCES OF INNOVATION 53 (1988). In particular, see C. T. TAYLOR & Z. A. SILBESTON, THE ECONOMIC IMPACT OF THE PATENT SYSTEM (1973), for findings from survey data from various industries that if the patent system were abolished, R & D expenditures would be reduced by 64% by the pharmaceutical industry and 25% by the specialty chemical industries, compared to 5% by the mechanical components industry and a negligible reduction by the electrical industries. *See also* Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development,* 1987 BROOKINGS PAPERS ECON. ACTIVITY 783, 793-98 (empirical study finding greater reliance on patents in chemical-related industries); PHARMACEUTICAL PANEL, NATIONAL RESEARCH COUNCIL, THE COMPETITIVE STATUS OF THE AMERICAN PHARMACEUTICAL INDUSTRY 9-14 (1980) (study of the industry's competitive position since World War II and the issuance of the patent on streptomycin in 1948 indicating the dependence of modern pharmaceutical firms on patents to support the extensive research investment required).

245 *Eli Lilly & Co.,* 630 F.2d at 124-25.

246 As Kitch noted:

> These arguments do not mean that no patents confer monopoly power upon their owners. Some of the drug patents, such as patents that achieved dramatic and unique reductions in the cost and effectiveness of medical care—probably have conferred monopolies upon their owners. But this analysis suggests that they are very exceptional cases.

Kitch, *Patents, supra* note 99, at 39.

spect to these low-cost, elegant inventions, patent-induced theory would seem to explain them equally as well. Such inventions would have been invented in any event, and granting a patent on them would be costly.[247] The prospect theory, of course, would predict validity of elegant inventions, whether high-cost or low-cost, which satisfy substantial novelty. The race-to-invent theory would have difficulty with sustaining such patents if they were granted a scope of protection that would retard improvements.[248]

2. Utility

To satisfy completely the requirements of § 101, the invention as claimed not only must fall within one of the statutory classes of invention, but also must be "useful," i.e., possess "utility."[249] In *Brenner v. Manson*,[250] the Supreme Court held that a process for making a steroid failed to meet the § 101 utility requirement when the steroid was undergoing *in vitro* screening as a possible tumor inhibiting agent in mice.[251] The Court concluded:

> The basic *quid pro quo* contemplated by the Constitution and the Congress for granting a patent monopoly is the benefit derived by the public from an invention with substantial utility. Unless and until a process is refined and developed to this point—where specific benefits exist in currently available form—there is insufficient justification for permitting an applicant to engross what may prove to be a broad field.[252]

The Court would appear to adopt a restrictive view of the reward theory, concluding: "But a patent is not a hunting license. It is not a reward for the search, but compensation for its successful conclusion."[253] Rent dissipation theory is said to be consistent with the result in *Manson*, because a court must have some indication of commercial value "in order to balance patent rent against avoided rent dissipation."[254] As a practical matter, it should follow that commercial success should be more determinative of

247 This is the logic of Judge Posner in Roberts v. Sears, Roebuck & Co., 723 F.2d 1324, 1345-48 (7th Cir. 1983) (en banc) (concurring and dissenting in part) that a quick release wrench was obvious as a matter of law because of its simplicity, low-cost to invent and ready market. *See supra* note 70 (discussing the *Roberts* case).

248 However, as elegant inventions are unimprovable by definition, it would seem the race-to-invent theory would not be greatly troubled by providing protection to such inventions. The question of whether a particular invention is to be classed as "elegant" in the sense of being unimprovable, is, of course, not one that is easily answerable.

249 *See* 35 U.S.C. § 101 (1988) (quoted *supra* note 22).

250 383 U.S. 519 (1966).

251 *Id.* at 531-32. Although not the basis for the court's rejection of the patent, the court found that a homologue to the steroid had been found effective as such an agent.

252 *Id.* at 534-35.

253 *Id.* at 536.

254 Grady & Alexander, *supra* note 7, at 339; *see also id.* at 339-40. They cite *Ex parte* McKay, 200 U.S.P.Q. (BNA) 324 (PTO Bd. Pat. App. & Int. 1975), and *Ex parte* Drulard, 223 U.S.P.Q. 364 (PTO Bd. Pat. Aph. & Int. 1983), as further examples of cases relating to the utility requirement being explained by the rent dissipation theory. The rationale is that, because the commercial value of these inventions was limited, the "signal" for improvement may be correspondingly low. *McKay* involved a process for extracting oxygen from extraterranial materials, and *Drulard* involved a portable lightning rod. With respect to *McKay*, Grady and Alexander state that the Board upheld a claim for the process. In fact, the Board found all appealed claims to be unpat-

utility than as an indication of nonobviousness. Nonetheless, the Court of Appeals for the Federal Circuit has limited the impact of *Manson*. In *Cross v. Iizuka*,[255] for example, the court found "practical utility," presumably on a factual basis, when an *in vitro* "pharmacological activity" is shown even though no specific use of the compound has been established. The holding in cases like *Cross* by the Court of Appeals for the Federal Circuit would seem to undermine the rationale of rent dissipation theory. It would seem highly difficult for a court to analyze the commercial value of a compound only having "pharmacological activity," whose ultimate use, if any, is yet to be determined.

The reward theory, in its narrow form, explains cases like *Manson*. No reward should be granted unless society receives a quid pro quo of an invention having commercial value. Reward theory will also conveniently explain cases like *Cross* by the expedient of construing a finding of "pharmacological activity" as justifying a reward. The demonstrated "activity" provides society with at least a starting point, but, for that matter, so did the steroid in *Manson*.

Patent-induced theory has great difficulty with a strict utility requirement because it is posited that the important inventions are revolutionary ones. Such inventions tend to be at the cutting edge of technology, with an unestablished commercial value and market. The requirement of commercial value may also be inconsistent with both race-to-invent and prospect theories, for under these theories the invention should be disclosed as quickly as possible so that the technology may be developed as expeditiously as possible. Indeed, the prospect theory would seem to envision a sort of "hunting license." On the other hand, race-to-invent theory may have difficulty if broad scope of coverage is provided to a compound that has merely displayed "pharmacological activity."

B. Conditions for Protection

1. Novelty

Section 102 is a relatively complex section of the Patent Act dealing with a variety of issues.[256] A basic issue is whether the invention satisfies the

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entable under 35 U.S.C. § 103 as being obvious. It would be consistent with all the theories, except perhaps the prospect theory, to deny protection to obvious inventions.

255 753 F.2d 1040 (Fed. Cir. 1985); *see* Request for Comments on Proposed Utility Examination Guidelines, 60 Fed. Reg. 97 (1994) (proposed Dec. 23, 1994), *reprinted in* 49 PAT. TRADEMARK & COPYRIGHT J. (BNA) 234 (1995).

256 Section 102 provides:

> A person shall be entitled to a patent unless -
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or
>
> (c) he has abandoned the invention, or
>
> (d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an

standard for protection of being novel. The novelty specified in paragraph (a) of § 102 is not absolute novelty in the sense that knowledge or use of the invention by another anywhere in the world would defeat novelty. The standard employed in § 102(a) is qualified novelty. The invention claimed must not have been "known or used by others in this country, or patented or described in a printed publication in this or a foreign country."[257] Moreover, the knowledge or use must be "public."[258] This doctrine explains the result in *Gayler v. Wilder*,[259] where the prior, but secret, use of a fireproof safe design was held by the Supreme Court not to defeat novelty of a later claimant for the patent. Rent dissipation theory is said to explain this result better because the secret use "could not have signaled the claimant's invention."[260] This conclusion cannot be assailed. Nonetheless, can it be said that the publication of a complete description of the safe in an obscure journal in an obscure foreign country and language would have signaled the invention, thus denying novelty? Rent dissipation may be reduced by the grant of the patent when there has been no public disclosure of the invention and, as yet, no opportunity for signaled improvements in the patent to be made. However, it would seem that a system of qualified novelty would encourage rent dissipation at the conception stage, as only *public* use, knowledge or publication defeats novelty. In *Gayler*, the fireproof safe had been invented a number of years prior to the patent at issue. It was then reinvented, at least once, with the consequence of rent dissipation.[261] Moreover, the fickleness of knowledge or use in the United States versus the requirement of a printed publication abroad are not easily explained by one signaling and the other not.

Another novelty problem not addressed by Grady and Alexander and not easily explained by rent dissipation is the denial of novelty of an invention on the basis of an earlier co-pending application, which describes the invention claimed in the later application. A leading example of this is

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application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States, or

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent, or

(f) he did not himself invent the subject matter sought to be patented, or

(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

35 U.S.C. § 102 (1988).

257 *Id.* § 102(a).

258 *See* CHISUM, *supra* note 179, § 3.05[2][a] (discussing and collecting cases).

259 51 U.S. (10 How.) 477 (1850).

260 Grady & Alexander, *supra* note 7, at 341.

261 Conner made the safe for his own use between 1829 and 1832. *Gayler*, 51 U.S. at 495. The Fitzgerald patent in issue was not granted until June 1, 1843, based on an application filed April 11, 1839. Thus, during the entire period of secret knowledge or use, rent dissipation appears to be encouraged rather than discouraged by a system of qualified novelty.

Alexander Milburn Co. v. Davis-Bournonville Co.,[262] where Justice Holmes reasoned that, when the first applicant had taken steps to make the disclosure public as soon as the Patent Office did its work, the later applicant should not benefit from the delay.[263] It can hardly be said that the earlier application signaled the latter invention, when it was kept secret in the PTO as required by statute.[264] Thus, because of this secrecy, it cannot be said that the race to improve has already taken place, justifying the denial of the patent. The result is that the invention of the later application goes into the public domain, initiating a race to improve contrary to rent dissipation theory.

Novelty doctrine, as described above, would appear to be better explained by the reward theory. No reward should be provided for reinvention, provided the public has received the potential benefit, at least, by the public knowledge, use, or publication of the earlier invention or its disclosure in a patent application. The race-to-invent theory would also support the denial of the patent, if there is public use, knowledge, or publication, because grant of the patent would interfere with competition in improvements. The same could be said with respect to the prospect theory, which justifies itself on the finding of "substantial novelty" to control the development of the improvements.

The second basic issue in § 102 is that of an inventor's self-destruction of novelty, i.e., statutory time bars. As provided in § 102(b), a patent will be denied if "the invention was described in a printed publication in this or a foreign country or in public use or sale in this country, more than one year prior" to the U.S. filing date.[265] The one year "period of grace" to file the application is another qualification to absolute novelty.[266] Most countries of the world do not provide such a period of grace.[267] Grady and Alexander attempt to explain time bars as follows: "The best explanation seems to be that the patent laws seek to avoid rent dissipation through secrecy."[268] A standard doctrinal rationale for this loss-of-right provision is

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262 270 U.S. 390 (1926).

263 *Id.* at 401; *see also* Hazeltine Research, Inc. v. Brenner, 382 U.S. 252 (1965) (extending reasoning of *Milburn* to rejections based on § 103 with regard to co-pending applications).

264 In the present codification, *see* 35 U.S.C. § 122 (1988) (confidential status of applications).

265 35 U.S.C. § 102(b) (1988) (quoted *supra* note 256). As explained by the court in TP Laboratories, Inc. v. Professional Positioners, Inc., 724 F.2d 965, 968 (Fed. Cir. 1984), *cert. denied*, 469 U.S. 826 (1984) (footnote omitted):

> More specifically, courts have discerned a number of factors which must be weighed in applying the statutory bar of § 102(b). Operating against the inventor are the policies of 1) protecting the public in its use of the invention where such use began prior to the filing of the application, 2) encouraging prompt disclosure of new and useful information, 3) discouraging attempts to extend the length of the period of protection by not allowing the inventor to reap the benefits for more than one year prior to the filing of the application. In contrast to these considerations, the public interest is also deemed to be served by allowing an inventor time to perfect his invention, by public testing, if desired, and prepare a patent application.

Id.

266 The grace period itself may be seen as contrary to the rent dissipation theory because during this year rent may be dissipating by others trying to develop the same invention.

267 The rationale for the period of grace, which used to be two years, is to provide time for inventors to prepare patent applications and have an opportunity to market their inventions as soon as possible. *See* 2 CHISUM, *supra* note 179, § 6.02.

268 Grady & Alexander, *supra* note 7, at 342.

that inventors should not be permitted to exploit their inventions commercially and only disclose them by means of the patent system when competition forces them to do so, hence extending their monopoly.[269] This rationale applies equally well to disclosing as well as nondisclosing commercial uses of the invention, as made clear by Judge Learned Hand in *Metallizing Engineering Co. v. Kenyon Bearing & Auto Parts Co.*[270] Rent dissipation theory may explain cases such as *Metallizing*. The incentive to file patent applications early would tend to avoid rent dissipation resulting from keeping the invention secret. On the other hand, it is not apparent why the denial of the patent because of secret commercial use would not stimulate a race to improve the invention once disclosed and hence dissipate rent.

The "on sale" bar in § 102(b) also is not easily explained by rent dissipation theory.[271] In such cases, there appears little rent dissipation by inventors keeping the invention secret. These inventors typically are just a bit too eager to market their inventions. Moreover, with the denial of the patent because it was "on sale," rent dissipation will occur in the race to improve, once the invention is disclosed publicly.

Moreover, the rent dissipation theory does not explain the "experimental use" exception to the statutory bars.[272] Under this exception, the inventor may noncommercially use the invention beyond the grace period to further develop it and still not be barred. However, rent may be dissipated in keeping the details of such inventions secret, which would otherwise be disclosed in a patent application, and rent may be dissipated in improving whatever is disclosed to the public in the experimental stage.

The reward and patent-induced theories seem to explain statutory bars better than the rent dissipation theory. The reward is offered to those inventors who rely upon the patent system and hence disclose their inventions in a timely manner to the public by means of the patent system. These theories tend to minimize reliance on secrecy and avoid the extension of the monopoly by secret exploitation of the invention is avoided. The patent-induced theory also tends to explain time bars. Most inventions that run afoul of public use or on sale bars tend to be market-induced inventions—inventors are overly anxious to get them to market. The patent-induced theory may particularly explain the experimental use excep-

269 The principal is of long lineage:

> If an inventor should be permitted to hold back from the knowledge of the public the secrets of his invention; if he should for a long period of years retain the monopoly, and make and sell his invention publicly, and thus gather the whole profits of it, relying upon his superior skill and knowledge of the structure; and then, and then only, when the danger of competition should force him to secure the exclusive right, he should be allowed to take out a patent, and thus exclude the public from any farther use than what should be derived under it during his fourteen years; it would materially retard the progress of science and the useful arts, and give a premium to those who should be least prompt to communicate their discoveries.

Pennock v. Dialogue, 27 U.S. (2 Pet.) 1, 19 (1827).

270 153 F.2d 516 (2d Cir.), *cert. denied*, 328 U.S. 840 (1946) (invalidation of process patent filed more than one-year from the sale of products made by the process).

271 *See generally* 2 CHISUM, *supra* note 179, § 6.02[6] (discussing and collecting cases on the "on sale" statutory bar).

272 *See generally id.* § 6.02[7] (discussing and collecting cases on the experimental use exception to § 102(b) statutory bars).

tion with respect to inventions that have not been fully developed and that require further experimentation prior to the inventor's capability to demonstrate their operability, let alone their marketability.

The race-to-invent theory would seemingly oppose a system of qualified novelty. However, it may explain a grace period, as this allows inventors to commercialize their inventions for a year without losing their patent rights. The "substantial novelty" required for patentability under the prospect theory presumably would explain either an absolute or a qualified system of novelty. The grace period would present a problem of worldwide coordination because most countries do not permit commercialization prior to filing for a patent.

The third major issue in § 102 is who should receive the patent when there are two or more applicants for the same invention.[273] Unlike the rest of the world, the United States employs a "first inventor" system rather than a "first-to-file" system.[274] Whenever there are multiple inventors, there are costs (rent dissipation) under either a first inventor or first-to-file system; nonetheless, the first-to-file system would tend to dissipate less rent. The first-to-file system encourages filing the application at an early stage of development and having the patent issued at an early stage. This would tend to minimize rent dissipation because the question of which applicant filed first is mechanically resolved and who first conceived the invention is irrelevant. In the United States, if two or more applicants can claim the same invention, an "interference" may be declared to resolve the issue of priority of invention.[275] This complicated, costly, and time-consuming *inter partes* procedure before the PTO delays the issuance of the patent, resulting in further rent dissipation.[276] Moreover, under the statute, the first inventor is not necessarily the one who first actually or constructively reduces the invention to practice; rather the first inventor may be the first to conceive yet last to reduce to practice, provided there is reasonable dili-

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273 35 U.S.C. § 102(g) (1988) (quoted *supra* note 256).

274 In a "first-to-file" system, the issue of who is entitled to the patent is resolved mechanically on the basis of who wins the race to the Patent Office, and pre-filing activity is irrelevant. Under the "first inventor" system in the United States, such pre-filing activity may be highly relevant and indeed determinative of who receives the patent. In the United States:

> The general rule as to priority of invention is that priority goes to the inventor who first reduced an embodiment of the invention to practice. This rule is subject to two exceptions. The inventor who was the first to conceive the subject matter but the last to reduce to practice will prevail if he exercised reasonable diligence in reducing to practice from a time just prior to when the first person to reduce to practice conceived the subject matter. Further, the second to reduce to practice will prevail if the first abandoned, suppressed, or concealed the invention.

3 CHISUM, *supra* note 179, § 10.01, at 10-4.

275 35 U.S.C. § 135 (1988) provides:

> (a) Whenever an application is made for a patent which, in the opinion of the Commissioner, would interfere with any pending application, or with any unexpired patent, an interference may be declared and the Commissioner shall give notice of such declaration to the applicants, or applicant and patentee, as the case may be. . . .
>
> (b) A claim which is the same as, or for the same or substantially the same subject matter as, a claim of an issued patent may not be made in any application unless such a claim is made prior to one year from the date on which the patent was granted.

Id.

276 Rent may be dissipated by the interference parties but also by others working on the same or related inventions.

gence on the part of that inventor from a time prior to the conception of the other inventor.[277] This would tend to promote rent dissipation at the conception stage, because early conception, rather than early filing, is rewarded.

The race-to-invent theory would appear to support a first-to-file system because of the greater likelihood of early disclosure of the invention and the opportunity for improvement. The same may be said of the prospect theory. If the mineral claim system is to be the model, the first to file the claim receives the grant. On the contrary, reward theory would tend to support the first-inventor system on a justice-based rationale that the reward should be granted to that individual who first provides the conceptual basis for the invention and then proceeds diligently to develop it. The patent-induced theory, incorporating the reward theory, would also seem to support the first inventor system, unless it could be maintained that it is more likely that the first inventor to file is more likely to be relying on the patent system.

The long pendency period of many patents also may result in rent dissipation, not only at the conception stage but also at the improvement stage. So-called "submarine" patents present a significant problem in many industries.[278] The U.S. patent system, which does not publish the patent disclosures until granted, would thus seem to be inherently rent dissipating and hence contrary to rent dissipation theory.

In summary, rent dissipation theory has a great deal of difficulty in explaining § 102 of the Patent Act. A qualified system of novelty would appear to increase rent dissipation at the conception stage. Statutory time bars tend to be explained if rent dissipation by secrecy is minimized; however, liberal application of the "on sale" bar and the experimental use exception are not explained. Moreover, rent dissipation theory fails to explain a patent system that does not require publication at an early date and does not award the patent to the first to file. Both of these result in rent dissipation of all three varieties—conception, improvement and secrecy. Rent dissipation theory, however, would seem to have considerable value as an analytical tool for weeding out inefficiencies in the present U.S. patent system. This theory would support the elimination of the one-year period of grace, the early publication of applications, and a first-to-file sys-

277 *See* 35 U.S.C. § 102(g) (1988) (quoted *supra* note 256). In Paulik v. Rizkalla, 760 F.2d 1270 (Fed. Cir. 1985), an applicant who actually reduced the invention to practice four years prior to filing, was permitted to rely upon its renewed activity from a date antedating the entry into the field by the opposing party, who was first to file an application on the same invention.

278 They are also sometimes called "time-bomb" or "shark" patents. An interesting historical example of this is the Selden patent covering the combination of an automobile, where the inventor, who happened to be a patent attorney, was able to keep the patent pending before the Patent Office for 16 years. This strategy failed. *See* Columbia Motor Car Co. v. C.A. Duerr & Co., 184 F. 893 (2d Cir. 1911); *supra* text accompanying notes 255-60. A recent example is the Hyatt patent (4,942516, issued July 17, 1990, based on an application filed Nov. 24, 1969) covering the invention of the microprocessor, which is said by the patentee, Gilbert Hyatt, to have spawned today's multibillion-dollar computer chip industry. Hyatt, who happens to be a patent agent in addition to an inventor, has successfully licensed his invention patent to various manufacturers, including North American Philips Corporation, Sony Corporation and Matsushita Electric Industrial Company, anticipating royalty revenues in the order of $100 million. *See* John Carey, *Inching Toward A Borderless Patent*, BUS. WK., Sept. 5, 1994, at 35; *Ex-Wife Sues for Micro Millions*, DAILY MAIL, June 2, 1993, at 10.

tem. All of these are under consideration as part of a Patent Law Harmonization Treaty and part of the implementation of the Trade Related Intellectual Property provisions negotiated in relation to the General Agreement on Trade and Tariffs.[279] Bills have been introduced in Congress to require publication of patent applications[280] and to change the term of a patent from 17 years from the grant date to 20 years from the filing date which would induce applicants to seek early grant of their patents.[281]

2. Nonobviousness

Prior to the 1952 Patent Act, those inventions that constituted statutory subject matter and that possessed utility and novelty still had to satisfy an implied standard of "invention."[282] The issue of "invention" often was resolved under negative rules of invention[283] or under doctrinal glosses, including the skill of the "ordinary mechanic"[284] or even the "flash of creative genius."[285] Section 103 of the 1952 Patent Act set out the standard of invention in terms of "nonobviousness,"—a patent will not be granted if the claimed invention "would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains."[286] The Supreme Court did not construe this section until

279 *See* DIPLOMATIC CONFERENCE FOR THE CONCLUSION OF A TREATY SUPPLEMENTING THE PARIS CONVENTION AS FAR AS PATENTS ARE CONCERNED, WORLD INTELLECTUAL PROPERTY ORGANIZATION, THE HAGUE, June 3-28, 1991; THE "BASIC PROPOSAL" FOR THE TREATY AND THE REGULATIONS, WORLD INTELLECTUAL PROPERTY ORGANIZATION, WIPO Doc. No. PLT/DC/3 (1990); NOTES ON THE BASIC PROPOSAL FOR THE TREATY AND REGULATIONS, WORLD INTELLECTUAL PROPERTY ORGANIZATION, WIPO Doc. No. PLT/DC/4 (1990); HISTORY OF THE PREPARATIONS OF THE PATENT LAW TREATY, WORLD INTELLECTUAL PROPERTY ORGANIZATION, WIPO Doc. No. PLT/DC/5 (1990). The treaty would require member-states to have a "first-to-file" system (Art. 9) and to publish applications (Art. 15); however, it would also require the provision of a "grace period." (Art. 12). Commerce Secretary Ron Brown announced in January 1994 that a "first-to-file" system would not be adopted in the United States. *See U.S. Says "Not Now" on First-to-File and Agrees with Japan on Patent Term*, 47 PAT. TRADEMARK & COPYRIGHT J. (BNA) 285 (1994). The change from a 17 year term from grant to a 20 year term from filing date and the publication of applications is far from assured. *See U.S.-Japan Conclude Agreement on Reexamination and Publication*, 48 PAT. COPYRIGHT & TRADEMARK J. (BNA), 412-13 (1994); *see also* Uruguay Round Agreements Act, Pub. L. No. 103-465, sec. 531-34, 108 Stat. 4809 (1994) (20 years from filing date with exceptions, one year grace period; however, no publication requirement or "first-to-file" system); *infra* notes 280 and 281 (difference in Senate and House bills). Whatever political compromise is ultimately reached may well support Judge Posner's conclusion that legislative rules "tend to be efficiency reducing." POSNER ECONOMIC ANALYSIS, *supra* note 14, at 523.

280 S. 1854, 103d Cong., 2d Sess. (1994) (Publication 18 months after filing).

281 H.R. 4505, 103d Cong., 2d Sess. (1994) (no publication required).

282 *See generally* NONOBVIOUSNESS—THE ULTIMATE CONDITION OF PATENTABILITY (J. Witherspoon ed., 1980) (compiling numerous articles concerning § 103). *See* Giles S. Rich, *The Vague Concept of "Invention" as Replaced by Section 103 of the Patent Act, id.* at 1:401 (discussing events leading to judicial imposition of invention requirement); Herbert H. Mintz & C. Larry O'Rourke, *The Patentability Standard in Historical Perspective: "Invention" to Section 103 Nonobviousness, id.* at 2:201 (tracing historical development of invention requirement).

283 *See* Anthony W. Deller, *The Problem of Invention in the Law of Patents*, 28 J. PAT. OFF. SOC'Y 797, 802 (1946) (listing 14 negative tests of patentability, including substitution of materials, reversal of parts, change of location, size, degree and form, and aggregation of parts).

284 Hotchkiss v. Greenwood, 52 U.S. (11 How.) 248, 267 (1850).

285 Cuno Engineering Corp. v. Automatic Devices Corp., 314 U.S. 84, 91 (1941) (stating that a new device cannot be patented, regardless of usefulness, if it does not demonstrate a flash of creative brilliance).

286 In its entirety, § 103 states:

1965 and then did so in the context of three cases commonly called the "trilogy."[287] In *Graham v. John Deere Co.*,[288] exhibiting a bit of revisionist history, the Court stated: "The standard has remained invariable in this Court".[289] It found the language of § 103 "strongly reminiscent"[290] of that in *Hotchkiss v. Greenwood*, decided in 1851, which required for invention that there be "more ingenuity and skill . . . than were possessed by an ordinary mechanic acquainted with the business."[291] The test to determine nonobviousness is expressly set out by the Court: "Under § 103, the scope and the content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved."[292] In applying this test to the Graham '798 patent, the Court found it obvious to reverse the position of the shaft of a plow from above to below the hinge plate.[293] The principal reference against the '798 was another patent previously issued to Graham—the '811 patent—which showed the shaft above the hingeplate.[294]

The rent dissipation theory is said to provide a more plausible explanation of *Graham* and other nonobviousness cases.[295] This is accomplished by categorizing the '798 plow as being an elegant invention because there were only two variations possible; thus, the '798 configuration was unimprovable and a patent was unnecessary to avoid rent dissipation.[296] Categorizing the '798 patent as elegant is rather curious in itself, in view of the historical background of these two patents. It would appear that the '798 patent was a defensive patent filed by Graham to preclude competition from using this particular design. Graham did not manufacture the '798 design but continued to employ the '811 design.[297] In 1953, the Fifth Circuit, in *Jeoffroy Manufacturing v. Graham*,[298] held the '811 patent valid and infringed. Jeoffroy changed its design during the course of this litigation

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> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made. Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

35 U.S.C. § 103 (1988).

287 Graham v. John Deere Co., 383 U.S. 1, 19 (1966); Calmar, Inc. v. Cook Chemical Co., 383 U.S. 1, 26 (1966); United States v. Adams, 383 U.S. 39 (1966). All three cases were decided the same day. *Calmar* and *Adams* appear under the caption *Graham v. John Deere Co.*

288 383 U.S. 1 (1966).

289 *Id.* at 19.

290 *Id.* at 14.

291 52 U.S. (11 How.) at 267.

292 383 U.S. at 17.

293 *Id.* at 25-26.

294 The '811 patent (2,493,811) was filed February 26, 1947 and issued January 10, 1980. The '798 patent (2,627,798) was filed August 27, 1951 and issued February 10, 1953.

295 Grady & Alexander, *supra* note 7, at 342-47.

296 *Id.* at 345.

297 As of 1964, Graham continued to manufacture plows according to the '811 design. *See* John Deere Co. v. Graham, 333 F.2d 529, 532 (8th Cir. 1964), *aff'd*, 383 U.S. 1 (1966).

298 206 F.2d 772 (5th Cir. 1953), *cert. denied*, 347 U.S. 920 (1954).

and brought a declaratory judgment action seeking a declaration of noninfringement of the '811 patent. Graham counterclaimed for infringement of both the '811 patent and the subsequently issued '798 patent. The district court held the '811 patent to be infringed under the doctrine of equivalents and held the '798 patent invalid.[299] In 1955, the Fifth Circuit reversed, refusing to apply such a broad interpretation of the doctrine of equivalents, thus holding '811 not infringed, but holding the '798 valid and infringed.[300] Since the Fifth Circuit narrowly construed the '811 patent as not covering a plow shank on the outside of the hinge plate according to the '798 design, the competitors could avoid the '811 patent. Thus, the '798 patent became the more important patent for Graham. However, in 1964, the Eighth Circuit's decision in *John Deere v. Graham*,[301] which the Supreme Court subsequently affirmed, held the '798 patent invalid.[302]

The reliance upon the '811 patent as a principal reference against the '798 patent, and the narrow reading of the '811 patent by the Fifth Circuit, draws into question the rent dissipation theory. If the '798 patent was invalid over the '811 patent, then it would seem to follow that the '811 patent must have signaled the '798 configuration. If the '798 configuration was elegant, it is not apparent why the '811 configuration also was not. If the '811 patent signaled the '798 configuration, this would result in rent dissipation in not interpreting the '811 patent broad enough to cover the obvious '798 alternative. Rent dissipation theory would suggest that the '811 patent should have been interpreted broadly enough to read on the '798 design and, hence, minimize rents that were dissipated by competitors trying to avoid the '811 patent.

In an attempt to discredit the nonobviousness standard and to advance their own, Grady and Alexander go so far to assert that inventions such as the pencil/eraser and Post-It Notes, said to have "revolutionized their field," were nonobvious, and to suggest otherwise would be "nonsensical."[303] If comparing the claimed invention with the prior art in the light of the requisite skill in that art is "nonsensical," is it "sensical" to categorize an invention as being elegant when its inventor preferred the original design ('811), which competitors attempted to design around, resulting in the invalidation of the alternative design (the defensive '798 patent)? Would the '798 patent have been held invalid in the absence of the '811 patent, and would the '811 patent have been sustained if Graham had patented the '798 configuration first? Rent dissipation theory does not seem to provide answers to these questions.

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299 Jeoffroy Mfg., Inc. v. Graham, 219 F.2d 511, 512 n.2 (5th Cir.) (the district court's opinion appears in note 2 of the case as set forth in two letters to the parties' counsel), *cert. denied*, 350 U.S. 826 (1955).

300 *Id.* at 516-20.

301 333 F.2d 529 (8th Cir. 1964), *aff'd*, 383 U.S. 1 (1966).

302 *Id.* John Deere, like Jeoffroy, tried to avoid infringement of the '811 and '798 patents by designing around them. *See* Graham v. John Deere Co., 216 F. Supp. 272, 277 (W.D. Mo. 1963), *rev'd*, 333 F.2d 529 (8th Cir. 1964), *aff'd*, 383 U.S. 1 (1966). In addition to the litigation costs, considerable rent dissipation must have occurred in attempting to design around the Graham patents.

303 Grady & Alexander, *supra* note 7, at 344.

Moreover, it would appear that the best explanation for *Graham* is found under the patent-induced theory, which is expressly adopted by the Supreme Court: "The inherent problem was to develop some means of weeding out those inventions which would not be disclosed or devised but for the inducement of a patent."[304] Thus, inventions that are obvious, such as the '798 modification of the '811 design, do not need the patent system to be created.[305] A fortiori simple, cheap, and highly marketable inventions, such as the pencil/eraser and Post-It Notes, are likely to be conceived and commercialized irrespective of the patent system, and without significant delay.

The race-to-invent theory could also nicely predict the invalidation of the '798 patent as permitting the free competition in improvements over the '811 patent; moreover, the narrow construction of the claims in the '811 patent would be consistent with this theory. The prospect theory would seem to predict broad interpretation of claims of the '811 patent as covering the '798 configuration or sustain the validity of the '798 patent.

The second case in the "trilogy" is not mentioned by Grady and Alexander, perhaps with some reason. The Supreme Court, in *Calmar, Inc. v. Cook Chemical Co.*,[306] invalidated a patent covering a closure mechanism for a pump-sprayer bottle which prevented leakage during shipping. The Court compared the claims to the prior art and concluded that this mechanism would have been obvious to a person skilled in the sealer art.[307] The invention was commercially successful and resolved a long-felt need in this industry.[308] Presumably, rent dissipation theory would justify this decision on the basis that the invention was elegant and did not signal any improvements. However, the claimed closure invention had been improved because both the accused infringer and the patent owner modified the original design to use a simpler rib and groove closure.[309]

The reward and patent-induced theories can explain the result in *Calmar*. The inventor deserved no reward for the obvious solution. The invention would appear to be a market-induced rather than a patent-induced invention. There was a long-felt need, and the commercial success of the invention demonstrated its marketability. It is likely that it would have been invented irrespective of the patent system, for it was a low-cost solution to a troubling problem.

The race-to-invent theory would also explain the result in *Calmar*, in particular with respect to both ignoring the commercial success of the product, and focusing on the quality of the invention itself. The prospect theory would reach the contrary result, provided there was "substantial nov-

304 *Graham*, 383 U.S. at 11.

305 There is some irony here because the '798 was patent-induced in the subjective sense. Graham obviously was relying upon the patent system in creating the alternative design and filing for a defensive patent to block competitors who would attempt to design around Graham's '811 plow.

306 383 U.S. 1, 26 (1966).

307 *Id.* at 32-37.

308 *Id.* at 35-36.

309 *Id.* at 31-32. This feature was disclosed in an analogous prior act but it still demonstrated that the original design could be improved. Was it too valuable compared to the signaled improvements?

elty" in the claimed device. Also, it might be noted that the market for closure devices would be a highly competitive one and the type of flat demand curve situation that Kitch predicts with respect to patents.

In the third case in the "trilogy," *United States v. Adams*,[310] the Supreme Court upheld a patent claiming a battery activated by water. The rent dissipation theory would distinguish this case from *Graham* on the basis that the Adams' patent signaled improvements.[311] Doctrine would explain the case in that Adams' invention was found nonobvious because the prior art taught away from a water activated battery. The remaining theories would also seem to support the validity of this patent.

Adams deserved the reward, as he took a contrarian view of what would work to provide a valuable invention. The patent would appear to be a patent-induced one. Adams was an independent inventor who took the risk of challenging conventional wisdom and devising a battery that would work with water.[312] The prospect theory would justify the validity on the basis that Adams should be the one to coordinate the development of this particular technical prospect. The race-to-invent theory also would sustain the patent, provided that the scope of protection was not so broad as to preclude the competition in improvements.

C. Scope Of Protection

As presented above, the respective economic theories have various degrees of difficulty in explaining whether a particular patent in a particular case would be held valid or invalid. Whenever a theory correctly predicts the validity of a patent, this does not end the case. The second critical issue is whether the patent found valid has been infringed. Thus, if the economic theory that correctly predicts the validity of the patent is to have full predictive value, it should also predict whether the patent is infringed. In-

310 383 U.S. 1, 39 (1966).

311 Grady & Alexander, *supra* note 7, at 346. *General Mills, Inc. v. Pillsbury Company*, 378 F.2d 666 (8th Cir. 1967), is the final case cited by Grady and Alexander to show that the rent dissipation theory better explains nonobvious decisions than does the doctrine itself. The invention was for a one-step angel food cake mix. Rent dissipation theory would not sustain this patent because the use of optimum proportions could not be improved. Grady & Alexander, *supra* note 7, at 346. The court concluded that Pillsbury's "contribution lies in determining the proper amount and proportion of acid and soda to be added to a batter to create a successful cake by a one stage mix." *General Mills*, 378 F.2d at 670. This combination of known ingredients was held unpatentable because it was obvious. *Id.* at 669-71. The reward and patent-induced theory would also support this result. It would appear that since one-step mixes were so valuable the market itself would induce their creation irrespective of the patent system. The prospect theory would be to the contrary in this highly competitive market. The race-to-invent theory would predict invalidity on technical merit, even in the light of the commercial success of the one-step mix.

312 Bert Adams conducted his experiments trying to perfect a water-activated battery in the kitchen of his apartment. One night while experimenting, ashes from his cigarette fell into cuprous oxide while being melted on the kitchen stove. He continued the experiment and used the mixture in his battery. The result was his invention with a sufficient current output being generated to light a small bulb at substantially constant voltage. He concluded that it was the carbon content in the cigarette ash acting as a catalyst that resulted in the increased current. He then experimented with other forms of carbon. The travails of Adams in making his invention and trying to obtain compensation from the government are told in RICHARD L. GAUSEWITZ, PATENT PENDING: TODAY'S INVENTORS AND THEIR INVENTIONS 54-64 (1983).

fringement is defined in § 271 of the Patent Act and requires that the accused infringer "make, use or sell" the claimed invention.[313]

1. Literal Infringement

For literal infringement, a claim of the patent must be read element by element on the accused subject matter. Literal infringement has generally been narrowly construed starting with *Prouty v. Ruggles*,[314] and reaffirmed in *Deepsouth Packing Co. v. Laitram Corp.*[315] *Deepsouth* held that packaging all the parts of a patented machine in the United States with instructions on how to assemble did not constitute infringement when the machine was assembled and used outside of the country. However, *Deepsouth* has been legislatively reversed.[316] Moreover, the Court of Appeals for the Federal Circuit has adopted a much more liberal construction of infringement. In *Paper Converting Machine Co. v. Magna-Graphics Corp.*,[317] the court held that it was infringement to "make" by partially assembling a patented machine, to "use" it by testing subassemblies, and to "sell" it in less than fully assembled form. The case was decided before the legislative reversal of *Deepsouth*, the court distinguishing *Deepsouth* by limiting it to export situations.[318]

Reward theory would support a scope of protection commensurate with the contribution made by the inventor. Thus, the narrow construction in *Deepsouth* of what constitutes a "making" may be inconsistent with reward theory, and the legislative reversal would rectify this. Also, the flexibility introduced by *Paper Converting* may be seen as explained by the re-

313 35 U.S.C.A. § 271(a) (West 1984 & Supp. 1995) ("Except as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patent invention during the term of the patent thereof, infringes the patent.").

314 41 U.S. (16 Pet.) 336 (1842). As the court stated:

> And this combination, composed of all the parts mentioned in the specification, and arranged with reference to each other, and to other parts of the plough in the manner therein described, is stated to be the improvement, and is the thing patented. The use of any two of these parts only, or of two combined with a third, which is substantially different, in form in the manner of its arrangement and connection with the others; is therefore not the thing patented. It is not the same combination if it substantially differs from it in any of its parts.

Id. at 341.

315 406 U.S. 518 (1972).

316 *See* 35 U.S.C.A. § 271(f) (West 1984 & Supp. 1995):

> (1) Whoever without authority supplies or causes to be supplied in or from the United States all or a substantial portion of the components of a patented invention, where such components are uncombined in whole or in part, in such manner as to actively induce the combination of such components outside of the United States in a manner that would infringe the patent if such combination occurred within the United States, shall be liable as an infringer.
>
> (2) Whoever without authority supplies or causes to be supplied in or from the United States any component of a patented invention that is especially made or especially adapted for use in the invention and not a staple article or commodity of commerce suitable for substantial noninfringing use, where such component is uncombined in whole or in part, knowing that such component will be combined outside of the United States in a manner that would infringe the patent if such combination occurred within the United States, shall be liable as an infringer.

Id.

317 745 F.2d 11 (Fed. Cir. 1984).

318 *Id.* at 17-19.

ward theory, thus enabling courts to fashion an appropriate scope of protection in line with the contribution made by the inventors. On the other hand, rent dissipation theory may have difficulty in explaining cases such as *Paper Converting* because, with an indefinite scope of protection, rent dissipation would seem to be increased at the improvement stage. If competitors are uncertain as to the scope of a patent, they may expend additional sums in an attempt to avoid the patent or pay royalties for commercialization beyond the scope signaled by the patent. Race-to-invent theory would be troubled by *Paper Converting* because the indefinite scope of the protection may act as a disincentive to competitors to risk improvements. Prospect theory would seem to explain the reversal of *Deepsouth* and the holding in *Paper Converting* to assure broad coordinating power to the patent owner.

Expanding the scope of protection may, in addition, have adverse consequences by increasing the incentive at the conception stage. Grady and Alexander cite *The Incandescent Lamp Patent* case,[319] *Columbia Motor Car Co. v. C.A. Duerr & Co.*,[320] *Wyeth v. Stone*,[321] and *Texas Instruments Inc. v. United States Int'l Trade Comm'n*[322] as examples of cases where the scope of protection claimed was considerably broader than the specific embodiments of the invention disclosed in the patent. While the claims of such patents literally read on accused subject matter, infringement was not found by the courts. This is the so-called "reverse doctrine of equivalents," limiting the claims to equivalents of what is actually disclosed in the patent.[323] Rent dissipation is said to explain this result because such broad protection would provide an added incentive at the conception stage and hence cause rent dissipation in attempting to secure the monopoly.[324] Grady and Alexander are correct that providing overly broad protection may provide too great an incentive at the conception stage, resulting in rent dissipation. However, they appear to have it wrong in their dismissive attitude of the value of knowing the state of the art: "Clever noninventors would pore over scientific and trade literature, ready to race to the Patent Office with claims broadly descriptive of a current set of *signals*."[325] The failure to pour

319 159 U.S. 465 (1895).

320 184 F. 893 (2d Cir. 1911).

321 30 F. Cas. 723 (C.C.D. Mass. 1840) (No. 18,107).

322 805 F.2d 1558 (Fed. Cir. 1986).

323 Boyden Power-Burke Co. v. Westinghouse, 170 U.S. 537, 568 (1897) ("We have repeatedly held that a charge of infringement is sometimes made out, though the letter of the claims be avoided. . . . The converse is equally true."); *see* 1 CHISUM, *supra* note 179, § 18.04[4]; *see also* Merges & Nelson, *supra* note 13, at 853-68 (economic rationale for doctrine).

324 Grady & Alexander, supra note 7, at 318-20, 328-29, 348.

325 *Id.* at 320 (emphasis added). It would seem that society may well owe a debt of gratitude to "clever" individuals pouring over the prior art, such as Felix Hoffman, who is said to have found aspirin more in the library, than in the laboratory. *See supra* text accompanying note 233.

Rather cryptically Grady and Alexander state: "If races among actual inventors are bad, presumably races among lawyers — from a rent dissipation point of view — would be worse." Grady & Alexander, *supra* note 7, at 320. Does this mean that patent or other lawyers cannot be "actual" inventors without, at least, going into the garage and dirtying their hands? As a matter of fact, Patent Attorney Selden evidently did get his hands dirty. He made improvements in the Brayton engine, as stated by the court in *Columbia Motor Car*: "To make these improvements we think that something more than mere mechanical skill was required, and, in view of the superior efficiency of the engine for the purpose for which it was designed, we hold that invention was involved."

over scientific and trade literature as well as the patent literature by inventors and noninventors alike would seem to be highly conducive to rent dissipation. "Reinventing the wheel" is a prime source of rent dissipation at both the conception and improvement stages as well as dissipating rent in keeping "secret" what is already in the public domain.[326]

These cases, admittedly, are consistent with the reward theory, for inventors should not be rewarded for something not invented.[327] At least the *Columbia Motor Car* case would seem inconsistent with the patent-induced theory, because the inventor, George Selden, was a patent attorney, and obviously he was relying upon the patent system.[328] However, as the patent-induced theory depends upon the reward theory, it would be consistent in the sense that, even if an invention is subsequently patent-induced, inventors should not be rewarded beyond their contribution to the art.

The race-to-invent theory would support the result in such cases of overly broad claiming, beyond what is taught by the inventor. The prospect theory, however, would be inconsistent with these cases because broad coordinating should be granted to the inventor.[329]

2. Doctrine of Equivalents

Under the doctrine of equivalents,[330] infringement may be held, even though the claim cannot literally be read on the accused subject matter when it "performs substantially the same function, in substantially the same way to obtain the same result."[331] In the leading case, *Graver Tank & Mfg.*

Columbia Motor Car, 184 F. at 907. Unfortunately for Selden it was the Otto engine that was improved and adopted by the industry. *See id.* at 910-11, 916.

326 One may be reminded of the admonition of the Supreme Court in Calmar, Inc. v. Cook Chemical Co., 383 U.S. 1, 36 (1966): "It is also irrelevant that no one apparently chose to avail himself of knowledge stored in the Patent Office and readily available by the simple expedient of conducting a patent search—a prudent and nowadays common preliminary to well organized research."

327 *See* Grady & Alexander, *supra* note 7, at 320 n.58.

328 Selden practiced in Rochester, N.Y., and was the first patent attorney retained by George Eastman, prosecuting Eastman's original patent on a process for coating dry plates. *See* WILLIAM GREENLEAF, MONOPOLY ON WHEELS: HENRY FORD AND THE SELDEN PATENT SUIT 8 (1961). Greenleaf provides a detailed history of the Selden patent controversy. Brief histories are found in JAMES J. FLINK, AMERICA ADOPTS THE AUTOMOBILE, 1895-1910, at 318-31 (1970); JOHN B. RAE, AMERICAN AUTOMOBILE MANUFACTURES: THE FIRST FORTY YEARS 72-81 (1959). Prior to being granted the patent on the motor car, Selden had been granted patents on other inventions, including a device for attaching rubber tires to wheels, apparatus for manufacturing barrel hoops and a typewriter. GREENLEAF, *supra*, at 9.

329 A rather perverse example of coordinating power was that attempted under the Selden patent. In 1899, Selden assigned his rights in the patent to the Electric Vehicle Co. for $10,000 and 20% of royalties derived from the patent. The Electric Co. was evidently hedging its bets that the electric automobile cars might lose out to gasoline powered ones. Rights to the Selden patent then were acquired by the Association of Licensed Automobile Manufacturers (ALAM), which was a trade organization formed to license the Selden patent in an attempt to regulate entry into the gasoline-powered automobile market. This attempted coordination proved largely unsuccessful. *See* FLINK, *supra* note 328, at 318-22. The ALAM had restrictive membership policies and, in a curious twist of fate, Selden himself having assigned his patent away, had to acquire a license under his own patent. He did this by acquiring a licensed manufacturer. *See* GREENLEAF, *supra* note 328, at 172-75.

330 *See generally* 1 CHISUM, *supra* note 179, § 18.04.

331 Graver Tank & Mfg. v. Linde Air Prods., 339 U.S. 605 (1950) (quoting Sanitary Refrigerator Co. v. Winters, 280 U.S. 30, 42 (1929) (quoting Machine Co. v. Murphy, 97 U.S. 120, 125 (1877))).

Co. v. Linde Air Prods. Co.,[332] the Supreme Court held that manganese was the equivalent of the claimed "alkaline earth metal" (magnesium), even though manganese is not an alkaline earth metal. Accordingly, an overly expansive reading of claims under the doctrine of equivalents, extending the patent to cover a wide scope of alternatives, may cause rent dissipation at the conception stage. This would have to be balanced against the diminution of rent dissipation at the improvement stage because of the doctrine. Nonetheless, uncertainty is introduced because of the inherent ambiguity of the scope of protection afforded under the doctrine. This inherent ambiguity is illustrated in Grady and Alexander's analysis of *Graver Tank*. Rather than talking in terms of equivalents, they state, "One could just as easily say the patentee's invention *signaled* the manganese variation."[333] While respondent's patent did disclose the use of manganese, such usage was already taught in the prior art.[334] Is the patentee to be given credit for re-signaling the state of the art?

Recent decisions of the Court of Appeals for the Federal Circuit on the doctrine of equivalents have further muddied the waters.[335] It is far from apparent that rent dissipation theory will rationalize these cases, especially if courts are expected to determine what is signaled and what is not signaled without further elaboration.

3. Contributory Infringement

Infringement can also be categorized into direct and indirect infringement. Direct infringement occurs when a given defendant either makes, uses or sells the patented invention in violation of § 271(a). Indirect infringement may be subdivided into induced and contributory infringement. Under § 271(b), induced infringement occurs when one causes another to directly infringe a patent by active inducement.[336] Contributory infringement occurs under § 271(c) when one sells an element for use in an invention when that element has no substantial noninfringing use (i.e., is "not a staple element of commence").[337] The sine qua non of induced

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332 339 U.S. 605 (1950).

333 Grady & Alexander, *supra* note 7, at 348 (emphasis added).

334 *Id.*; *see Graver Tank*, 339 U.S. at 610-11.

335 *See* 4 CHISUM, *supra* note 179, § 18.04[1]; *see also* Pennwalt Corp. v. Durand-Wayland, Inc., 833 F.2d 931 (Fed. Cir. 1987) (en banc), *cert. denied*, 485 U.S. 961, *and cert. denied*, 485 U.S. 1009 (1988) (adopting an "all elements" analysis but compare the various views of the judges on the doctrine). The *Pennwalt* decision has generated a plethora of recent commentary. *Compare* Atlas Powder Co. v. E.I. duPont de Nemours & Co., 750 F.2d 1569, 1582 (Fed. Cir. 1984) (relevance of "heart of the invention" to equivalents analysis) *with* Perkin-Elmer Corp. v. Westinghouse Elec. Corp., 822 F.2d 1528, 1531 n.6 (Fed. Cir. 1987) (not infringement under doctrine of equivalents if achieves the result in a substantially different way).

336 35 U.S.C. § 271(b) (1988) provides, "Whoever actively induces infringement of a patent shall be liable as an infringer."

337 Section 271(c) states:

> Whoever sells a component of a patented machine, manufacture, combination or composition, or a material or apparatus for use in practicing a patented process, constituting a material part of the invention, knowing the same to be especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial noninfringing use, shall be liable as a contributory infringer.

35 U.S.C. § 271(c) (1988).

and contributory infringement is direct infringement. This was the problem in *Deepsouth*.[338] There was no direct infringement in the United States of the U.S. patent; thus the defendant could not be held to have induced or contributed to its infringement.

The scope of protection afforded under a given patent may be augmented, depending upon how indirect infringement principles are applied in actual cases. An interesting case for the application of economic theories is *Dawson Chemical Co. v. Rohm & Haas Co.*[339] *Dawson Chemical* involved the interface of contributory infringement, under § 271(c) with the patent misuse doctrine, under § 271(d).[340] The Supreme Court held that the defendant contributorily infringed plaintiff's patent on a process for applying propanil as an herbicide in rice fields. Propanil was an unpatented compound that had no other use but that specified in the patented process. Defendant, by selling propanil with instructions on how to apply according to the patented method, was contributing to the infringement of the patent, and the farmers who actually applied the propanil were direct infringers.[341] The Court held that there was no misuse in the patentee's refusal to license the defendant to sell propanil for use in its only known application.[342]

The result in *Dawson Chemical* is consistent with the reward theory. The inventor had contributed a valuable process to the public by employing a previously useless compound. It is not apparent whether the invention was patent-induced. However, a case can be made that it was, because there was considerable interest in propanil, and it is unlikely that continued experimentation would have occurred unless patent protection could be obtained on an invention that could so easily be infringed upon. Rationalizing the *Dawson Chemical* case with rent dissipation theory is not so easy. In the first place, there was considerable rent dissipation in the attempt to acquire the patent over propanil.[343] Second, and perhaps more importantly, the invention was elegant for it is not apparent what improvements could be signaled. All the invention entailed was the discovery that

338 Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518, 526 (1972).

339 448 U.S. 176 (1980).

340 Section 271(d) now states the following:

> No patent owner otherwise entitled to relief for infringement or contributory infringement of a patent shall be denied relief or deemed guilty of misuse or illegal extension of the patent right by reason of his having done one or more of the following: (1) derived revenue from acts which if performed by another without his consent would constitute contributory infringement of the patent; (2) licensed or authorized another to perform acts which if performed without his consent would constitute contributory infringement of the patent; (3) sought to enforce his patent rights against infringement or contributory infringement; (4) refused to license or use any rights to the patent; or (5) conditioned the license of any rights to the patent or the sale of the patented product on the acquisition of a license to rights in another patent or purchase of a separate product, unless, in view of the circumstances, the patent owner has market power in the relevant market for the patent or patented product on which the license or sale is conditioned.

35 U.S.C. § 271(d) (1988). At the time of *Dawson Chem.*, only subparagraphs (1), (2) and (3) were specifically excluded from being classified as misuse. Subparagraphs (4) and (5) were added by the Patent and Trademark Authorization Act of 1988, Pub. L. No. 100-703, 102 Stat. 4676 (codified at 35 U.S.C. § 271(d) (1988)).

341 *Dawson Chem.*, 448 U.S. at 183.

342 *Id.* at 202.

343 *See supra* note 227.

propanil would work as an herbicide when mixed with water and applied to rice fields. Thus, it is difficult to perceive how rent dissipation theory would explain *Dawson Chemical* consistently with cases such as *Morton*[344] and the *pencil/eraser*[345] cases. Also, granting protection to previously known compounds, whether having other uses or a "first" use, such as propanil, would seemingly cause rent dissipation at the conception stage, because there would be a great race to develop such new-use inventions that signaled little, if any, means for technological improvement.

The result in *Dawson Chemical* would be consistent with prospect theory enabling the patent owner to coordinate the development of this particular herbicide, by exploitation itself or by licensing, which it refused to do. The race-to-invent theory may be troubled by the *Dawson Chemical* decision, because of the broad scope of protection afforded under the patent. The protection granted to the first use of propanil is tantamount to granting a monopoly over the compound itself.

If any generalizations can be made concerning the predictability of infringement according to the economic theme of theories, they are not readily discernible. All the theories, except the prospect theory, support limiting the scope of claims to the contribution made by the invention disclosed. The reward, patent-induced, and prospect theories better explain a broad interpretation of literal infringement than do the rent dissipation and race-to-invent theories. The same may be said in respect to the nonliteral infringement under the doctrine of equivalents and indirect infringement (induced and contributory). The problem with the rent dissipation theory, in particular, is that a broad scope of protection may induce rent dissipation at the conception stage and retard it at the improvement stage. On the other hand, a narrow scope will retard rent dissipation at the conception stage but induce it at the improvement stage. Moreover, narrow protection may induce dissipation by increased expenditures to maintain secrecy. It is not at all apparent how rent dissipation predicts a scope that optimizes the efficient allocation of resources.

D. A Word on "Signals"

Of singular importance to the rent dissipation theory is the word "signal." Whether improvements are signaled determines whether the patent will be sustained and the content of those signals is determinative of the scope of protection.[346] As stated by Grady and Alexander: "A patentable invention is one where the size of the patent rent corresponds to the quality of the *signal* for improvement coming from the technological information actually disclosed by the patent application."[347] Presumably, they mean the technological information actually disclosed in the patent as published and made available to the public; however, at times they indicate the

344 Morton v. New York Eye Infirmary, 17 F. Cas. 879 (S.D.N.Y. 1862) (No. 9,865); *see supra* text accompanying notes 170-78.

345 Reckendorfer v. Faber, 92 U.S. 347 (1875); Rubber Tip Pencil Co. v. Howard, 87 U.S. (20 Wall.) 498 (1874); *see supra* text accompanying notes 191-96.

346 Grady & Alexander, *supra* note 7, at 309, 319-20, 348.

347 *Id.* at 319 (emphasis added).

invention signals[348] and at others the *patent* signals.[349] As the claims constitute part of the patent specification, presumably they should also be capable of signaling.[350] Whatever signals appear in the application would be fixed at the filing date.[351] Grady and Alexander recognize the difficulty that courts might have in appraising technological signals before the invention has been fully developed. Nonetheless, they would authorize the court to rely upon hindsight at the time of litigation, so that the court could look back from that time to determine whether the invention or patent had actually signaled the accused subject matter.[352] This is a rather peculiar approach, because courts are constantly cautioning against the use of hindsight in patent law, particularly with respect to the obviousness issue, where 20/20 vision in hindsight is the bane of inventors.[353]

Grady and Alexander assert that courts have "developed some fairly rigorous signaling principles."[354] Supposedly, these principles are implied in *The Incandescent Lamp Patent* case[355] [hereinafter *Lamp*] and *Columbia Motor Car Co. v. C.A. Duerr & Co.*[356] Grady and Alexander conclude that, in these cases, the invention or patent did not signal the allegedly infringing lamp or automobile at the time of filing, even though the claims were broad enough to read literally upon the accused subject matter.[357] The claims thus did not seem to shed a very bright signal light. Would a different result have been reached if the Sawyer and Man patent at issue in the *Lamp* case had included a comprehensive listing of every conceivable filament material, including by chance the Japanese bamboo actually used by

348 *Id.* at 308-09, 318, 320.

349 *Id.* at 319.

350 "The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention." 35 U.S.C. § 112 ¶ 2 (1988).

351 Applicants are prohibited from introducing new matter into their applications after the filing date:

> (a) No amendment shall introduce new matter into the disclosure of an application after the filing date of the application (§ 1.53(b)). All amendments to the specification, including the claims, and the drawings filed after the filing date of the application must conform to at least one of them as it was at the time of the filing of the application. Matter not found in either, involving a departure from or an addition to the original disclosure, cannot be added to the application after its filing date even though supported by an oath or declaration in accordance with § 1.63 or § 1.67 filed after the filing date of the application.
>
> (b) If it is determined that an amendment filed after the filing date of the application introduces new matter, claims containing new matter will be rejected and deletion of the new matter in the specification and drawings will be required even if the amendment is accompanied by an oath or declaration in accordance with § 1.63 or § 1.67.

Rules of Practice in Patent Cases, 37 C.F.R. § 1.118 (1994).

352 Grady & Alexander, *supra* note 7, at 320.

353 *See, e.g.*, Burlington Indus. v. Dayco Corp., 849 F.2d 1418, 1420 (Fed. Cir. 1988) ("The trial court, after the controversy had arisen, and with the '20-20 vision of hindsight', read the patent entirely differently than did those concerned with its issue."); Fields v. Schuyler, 472 F.2d 1304, 1306 (D.C. Cir. 1972) ("The judge's experience enables him to compensate for the tendency of inventions to look obvious—with the 20-20 vision of hindsight."), *cert. denied*, 411 U.S. 987 (1973); Collins v. Kraft, 144 F. Supp. 162, 167 (D. Md. 1956) ("with the 20/20 vision of hindsight it may now appear simple . . . .").

354 Grady & Alexander, *supra* note 7, at 319.

355 159 U.S. 465 (1895).

356 184 F. 893 (2d Cir. 1911).

357 Grady & Alexander, *supra* note 7, at 319-20.

Edison?[358] A similar question could be posed concerning the *Columbia Motor Car* case: Would the result have differed if the Selden patent had specifically listed every known automobile engine?[359] After all, Selden's patent specification stated: "Any form of liquid hydrocarbon engine of the compression type may be employed in my improved locomotive."[360] Would the result in *Columbia Motor Car* be different if Selden had added: "including, in particular, the *Brayton* and *Otto* engines and any modifications and improvements thereof"? Selden, however lacking prescience, selected the Brayton engine for improvement, while the Otto evolved into the industry standard. Of course, whatever was included in the Selden application signaled very little, for it was pending in the Patent Office for sixteen years, during a period of many improvements in automobiles and engines.[361]

Because signaling is so important, this would suggest that patent applications should be encyclopedic in nature and should include every conceivable potential improvement to support not only the patentability of the invention but also its infringement at a later date. Patent attorneys, no doubt, would embrace rent dissipation theory with alacrity, provided inventors or their assignees would be willing to pay for such comprehensive applications. Such comprehensive applications might also assuage the Supreme Court's concern that the disclosure of inventions in patents often is inadequate.[362] Rent dissipation certainly would be consistent with the best mode requirement under § 112 and, moreover, would suggest that all modes should be disclosed in order to minimize rent dissipation at the

358 In November 1879, Edison filed his patent application on a light bulb with a carbon filament in a spiral shape. This filament proved to be too brittle for commercial production. A worldwide search was undertaken by Edison for the best filament material available in commercial quantities. Japanese bamboo was finally selected. Initially, light bulbs using Japanese bamboo filament would last for about 3 1/2 hours. By the end of 1880, they would burn for at least 240 hours. *See* FLATOW, *supra* note 142, at 21; *see also id.* at 26 (using "The Light Bulb Hall of Fame" to chart the municipal developments from 1802 to Edison's bulb in 1879).

359 Both the Brayton and Otto engines were prior art. The court stated in *Columbia Motor Car*:

> The phrase in the claim, "a liquid hydrocarbon engine of the compression type," is descriptive of the Brayton engine, which came into use about 1873, and of the Otto compression engine, which came into use a little later but still was in the antecedent art. The Brayton was undoubtedly the leading compression engine at the time of this application, but it was later superseded by the Otto.

Columbia Motor Car, 184 F. at 898.

360 *Id.* at 901.

361 As the court recognized:

> It is apparent that [Selden] delayed just as long as possible the issue of the patent to him. During this long time the automobile art made marked advances along different lines, and when, in 1895, the patent was granted, it disclosed nothing new. Others had then made the patentee's discovery and had reduced it to practice in ignorance of what he had done. While he withheld his patent, the public learned from independent inventors all that it could teach. For the monopoly granted by his patent he had nothing to offer in return. The public gained absolutely nothing from his invention, whatever it was. From the point of view of public interest it was even better that the patent had never been granted.

Id. at 894-95.

362 *See, e.g.*, Brenner v. Manson, 383 U.S. 519, 534 (1966) ("[I]n light of the highly developed art of drafting patent claims so that they disclose as little useful information as possible . . . the argument based on the virtue of disclosure must be warily evaluated.").

improvement stage.[363] Of course, courts may then find it necessary to distinguish "real" signals from "padded" ones.

V. CONCLUSION

The analogy between a unified theory in physics and a unified economic theory of patents is admittedly a loose one. Nonetheless, while the same degree of scientific verifiability cannot be expected of economic theory, methodological rigor may not be ignored. It is not only science that warns against overgeneralizations from limited data. Considerable doubt may be cast on any theory that does the following: premises itself on a limited number of non-randomly selected cases;[364] relies upon the subjective evaluation of inherently ambiguous terms;[365] presumes all cases are decided rightly;[366] limits evaluation of the underlying patented invention to the four-corners of the reported case opinion;[367] runs counter to the "Law of Parsimony;"[368] and attempts to show superior predictive power by comparing the theory to other theories designed for macro-level evaluation of the patent system as a whole system rather than micro-level prediction of the outcome of actual cases.

Within the constraints of the "uncertainty principle" (that statistical probability of outcome is the best that can be expected), the outcome of actual patent litigation may better be explained on the attitude (bias) of the court toward patents at the time of decision. The change in the Supreme Court's attitude from *Deepsouth* and *Benson* to *Dawson Chemical* and *Chakrabarty* is enlightening. In *Deepsouth* and *Benson*, the Court took a very narrow view of patents, some would say an antipatent view,[369] while in *Dawson Chemical* and *Chakrabarty* the mood had shifted to a more expansive view of what Congress had signaled.[370] With the shifting of jurisdiction over patent appeals from the respective circuits to the Court of Appeals for the Federal Circuit, there has been a steady increase in the percentage of patents found valid and infringed.[371] The pro-patent bias of the Court of

363 *See* 35 U.S.C. § 112 (requiring that the "specification shall . . . set forth the best mode contemplated by the inventor for carrying out his invention").

364 *Cf.* Richard A. Posner, *A Theory of Negligence*, 1 J. LEGAL STUD. 29 (1972) (study of over 1500 tort cases concluding the negligence standard produces an efficient allocation of resources). *See generally* WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF TORT LAW (1987).

365 For example, "signals," "elegant."

366 *See* Merges, *Rent Control*, *supra* note 126, at 367 ("Explaining cases that are no longer good law comes perilously close to prescribing a normative theory. . . ."). Some cases, of course, were never "good law."

367 *See, e.g.*, *supra* text accompanying notes 282-303 (discussing the Graham '811 and '798 patents).

368 *See supra* note 128 and accompanying text (discussing the contention by Grady and Alexander that courts in patent cases reverse "Occan's Razor" ("Law of Parsimony")).

369 *See, e.g.*, Chisum, *Algorithms*, *supra* note 190, at 961 (charging the Supreme Court with an "antipatent judicial bias" with reference to the *Benson* case).

370 *See* A. Samuel Oddi, *Contributory Infringement/Patent Misuse: Metaphysics and Metamorphosis*, 44 U. PITT. L. REV. 73, 80-81 (1982) (tracing the demise of the "clear and certain signal" test for limiting patent protection).

371 From 1921 through 1973, courts of appeals invalidated 65% of the patents, while district courts invalidated 55%. Lawrence Baum, *The Federal Courts and Patent Validity: An Analysis of the Record*, 56 J. PAT. OFF. SOC'Y 758, 760-61 (1974). From 1948 through 1977, limited to the issue of

Appeals for the Federal Circuit is palpable and may offer a far better indicator of patent validity and infringement than any of the economic theories.[372]

While economic theory, as presently understood and developed, may not be capable of proving that the patent system provides a net benefit to society or of predicting with any consistency the outcome of actual patent cases, the study of such theories is believed to have considerable value if this may lead to making the existing patent system more efficient. Economic theory may provide a powerful analytical tool for identifying patent law rules and doctrines that produce inefficient results. Once these inefficiencies are identified, they may be addressed by statutory amendment and in the litigation process.[373] Over time, society, at the margin, should benefit.

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nonobviousness, 52% of patents were held invalid by district courts and 64% by the courts of appeals. Myron Cohen, *Nonobviousness and the Circuit Courts of Appeal—Twenty-five Years in Review, in* NONOBVIOUSNESS—THE ULTIMATE CONDITION OF PATENTABILITY, *supra* note 282, at 3:1, 3:13. During the first three years of operation of the Court of Appeals for the Federal Circuit with respect to appeals from district court, the invalidation rate decreased to 46% on the obviousness issue and 50% on 35 U.S.C. § 102 issues. If 35 U.S.C. § 112 issues are included, the overall percentage of invalidity was 44%. Donald R. Dunner, *The Court of Appeals for the Federal Circuit—Its First Three Years: Introduction*, 13 AIPLA Q.J. 185, 186-89 (1985). In a later study, the Court of Appeals for the Federal Circuit found validity in substantially all cases (only 3 out of 28 were reversed), whereas trial courts were equally likely to reverse as to affirm invalidity. *See* Ronald B. Coolley, *What the Federal Circuit Has Done and How Often: Statistical Study of the CAFC Patent Decisions—1982 to 1988*, 71 J. PAT. OFF. SOC'Y 385, 391 (1989). It is also interesting to note that the Court of Appeals for the Federal Circuit reversed a validity holding only 14 times out of 120 opportunities, thus indicating an affirmance rate of approximately 88%. *See* ROBERT L. HARMON, PATENTS AND THE FEDERAL CIRCUIT 639 (2d ed. 1991).

372 *Cf.* Chief Judge Markey's speech to the Section of Patent, Trademark and Copyright Law at the August 8, 1989 annual meeting of the American Bar Association in Honolulu, Hawaii, where the patent bar was admonished to refute the "slur" that statistics, without reference to the merit of individual cases, show the Court of Appeals for the Federal Circuit to be biased in favor of patents. The speech, titled "Courts are Clients Too" is reprinted in 8 PTC Newsletter, Summer/Fall 1989, at 3. These comments were evidently in response to published statistical analysis of Court of Appeals for the Federal Circuit validity and infringement decisions. *See supra* note 270. *But see* Rochelle C. Dreyfuss, *The Federal Circuit: A Case Study in Specialized Courts*, 64 N.Y.U. L. REV. 1, 26-27 (1989) (identifying some patent law decisions favoring patentees).

373 *See* POSNER, *supra* note 14, at § 19.2 (indicating that inefficient rules are likely to be litigated).